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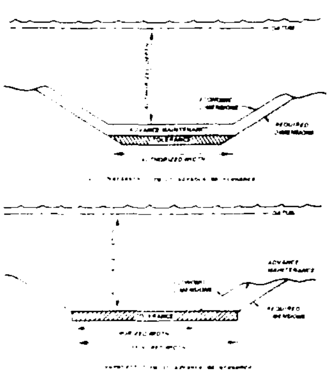

HYDRAULICS
LABORATORY

IMPROVEMENT OF OPERATIONS AND MAINTENANCE
TECHNIQUES RESEARCH PROGRAM

TECHNICAL REPORT HL-88-16

ADVANCE MAINTENANCE IN ENTRANCE CHANNELS: EVALUATION OF SELECTED PROJECTS

Hydraulic Model Investigation

by

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One of the techniques used by the US Army Corps of Engineers to alleviate the high costs of maintenance dredging necessary to provide adequate dimensions in the entrance channels to the ports and harbors of the United States is known as advance maintenance dredging. Advance maintenance is defined as the channel dredging dimensions beyond the dimensions economically feasible required to maintain the dimensions during the budget year or until the next dredging cycle. This report evaluated the effectiveness of advance maintenance in producing desired results by examining its effects on the shoaling characteristics of 10 entrance channels. Three of the channels are located on the southeast Atlantic coast of the United States, three on the Gulf coast, and four on the northwest Pacific coast. At some of the sites, the effect of channel enlargement was included, since the initial performance of advance maintenance along a particular channel segment is

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technically "new work" dredging. Evaluations presented were based on an empirical technique of analysis using data from hydrographic survey maps and historical dredging records obtained from Corps District Offices. A brief description of its physical and hydraulic characteristics is included with the evaluation of each project. Results obtained in this study varied among the projects. In general, overdepth advance maintenance was most beneficial at projects where the infill rate was not sensitive to dredged depth while overwidth advance maintenance appeared to be most effective in channels where the location of the problem shoal was consistent from season to season. It is recommended that an analysis of the shoaling characteristics of a navigation project be conducted prior to the implementation of advance maintenance dredging at that project.

PREFACE

The study reported herein was conducted by personnel of the Hydraulics Laboratory, US Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi, under the Improvement of Operations and Maintenance Techniques (IOMT) research program, sponsored by the Headquarters, US Army Corps of Engineers (USACE), US Army, under IOMT Work Unit No. 31683, "Fine-Grained Shoaling in Navigation Channels." This is the fourth report dealing with the results of an in-depth investigation of the practice of advance maintenance dredging.

The study was conducted during the period 1982 to 1986 under the direction of Messrs. H. B. Simmons and F. A. Herrmann, Jr., former and present Chiefs, Hydraulics Laboratory, and Messrs. R. A. Sager and W. H. McAnally, former and present Chiefs, Estuaries Division. The IOMT Program Manager during this period was Mr. E. C. McNair, Estuarine Engineering Branch, Estuaries Division. This report was prepared by Messrs. M. J. Trawle, Estuaries Division, and J. A. Boyd, Estuarine Engineering Branch, and edited by Mrs. Nancy Johnson, Information Technology Laboratory, under the Inter-Governmental Personnel Act. USACE Technical Monitor was Mr. James L. Gottesman.

COL Dwayne G. Lee, CE, is the Commander and Director of WES. Dr. Robert W. Whalin is Technical Director.

CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC)
UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
acres	4,046.873	square metres
acre-feet	1,233.489	cubic metres
cubic feet	0.02831685	cubic metres
cubic yards	0.7645549	cubic metres
feet	0.3048	metres
miles (US statute)	1.609344	kilometres
square miles (US statute)	2.589998	square kilometres
tons (2,000 pounds mass)	907.1847	kilograms

ADVANCE MAINTENANCE FOR ENTRANCE CHANNELS: EVALUATION OF SELECTED PROJECTS

Hydraulic Model Investigation

PART I: INTRODUCTION

Background

1. High inflation rates of the mid-1970's and late 1970's caused a dramatic increase in the cost of maintaining authorized or economic dimensions in the entrance channels to the ports and harbors of the United States. Inflation directly affected the cost of items such as labor and fuel associated with each phase of a maintenance dredging operation. These phases range from plant mobilization and demobilization through the actual dredging, transporting, and disposal of material, to the hydrographic surveys often required before and after each maintenance operation.

2. In addition to soaring rates of inflation, there were other factors that contributed to the rising cost of a maintenance dredging operation. Among these factors were the new stringent environmental regulations concerning dredging and dredged material disposal.

3. The US Army Corps of Engineers is responsible for maintaining many entrance channels at dimensions adequate for the using traffic. In an effort to reduce annual maintenance costs by extending the interval between dredging operations, the Corps performs advance maintenance dredging at critical, fast-shoaling areas of many entrance channels and other navigation projects. Advance maintenance is defined as the channel dredging dimensions beyond the economic dimensions required to maintain the economic dimensions during the budget year or until the next dredging cycle.

4. The economic dimensions of a channel are determined by the most favorable benefits-to-cost ratio. Economic dimensions are always equal to or less than authorized dimensions. They are based on using traffic requirements and maintenance costs at increments up to and including authorized dimensions.* Authorized dimensions are specified by congressional action.

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* Personal Communication, 28 June 1985, Commanders, US Army Engineer Divisions, WRSC-D, Subject: Dredging Policies and Practices.

5. Advance maintenance is exclusive of the allowable dredging tolerance which recognizes the inaccuracies inherent in dredging operations. The allowable tolerance portion of overdepth dredging is applied only in the horizontal plane immediately below the dredging area and may not exceed 2 ft* or 20 percent of the total dredging quantity, whichever is less, unless a specific waiver has been specified by the Division Engineer.**

6. Figure 1 illustrates a cross-sectional view, with definitions, of a typical dredged channel, maintained at authorized dimensions. Advance maintenance is not included. The authorized depth, bottom width, and side slopes describe the authorized channel prism. Payment for the volume of material removed is determined by including the material removed from within the tolerance limits with that material removed from the authorized channel prism.

7. Figure 2 illustrates cross-sectional views, with definitions, of a typical dredged channel, maintained at authorized dimensions with advance maintenance included. Payment for material removed is determined as stated in paragraph 6 with the addition of payment for material removed from within the advance maintenance prism.

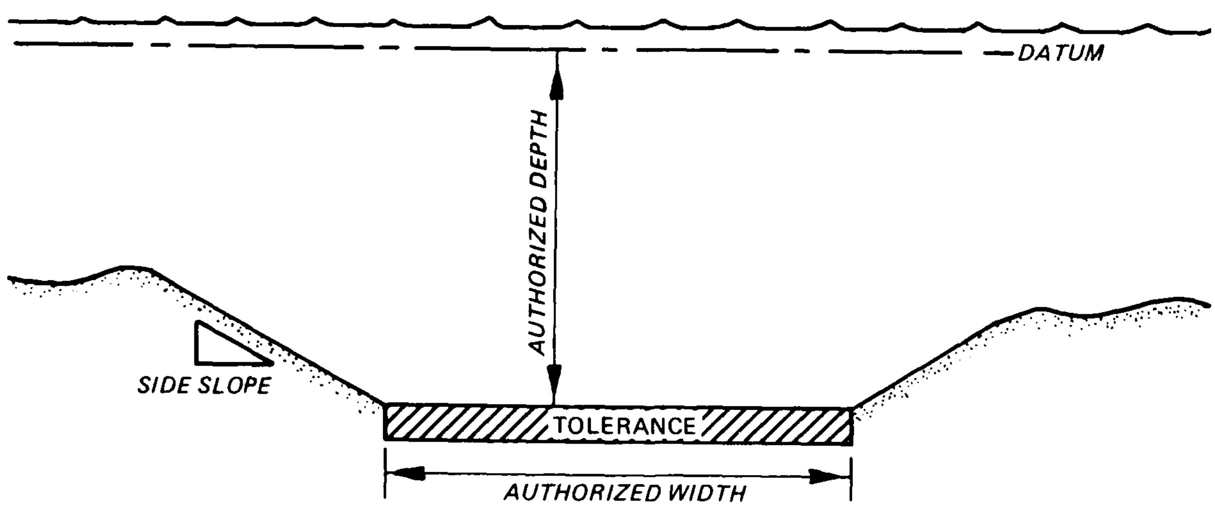
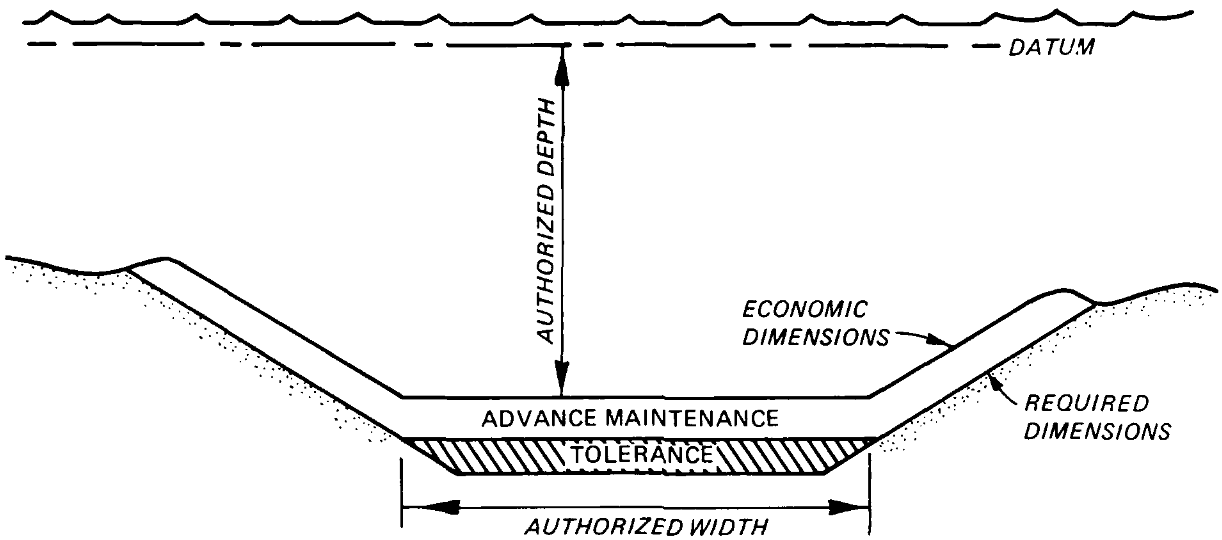
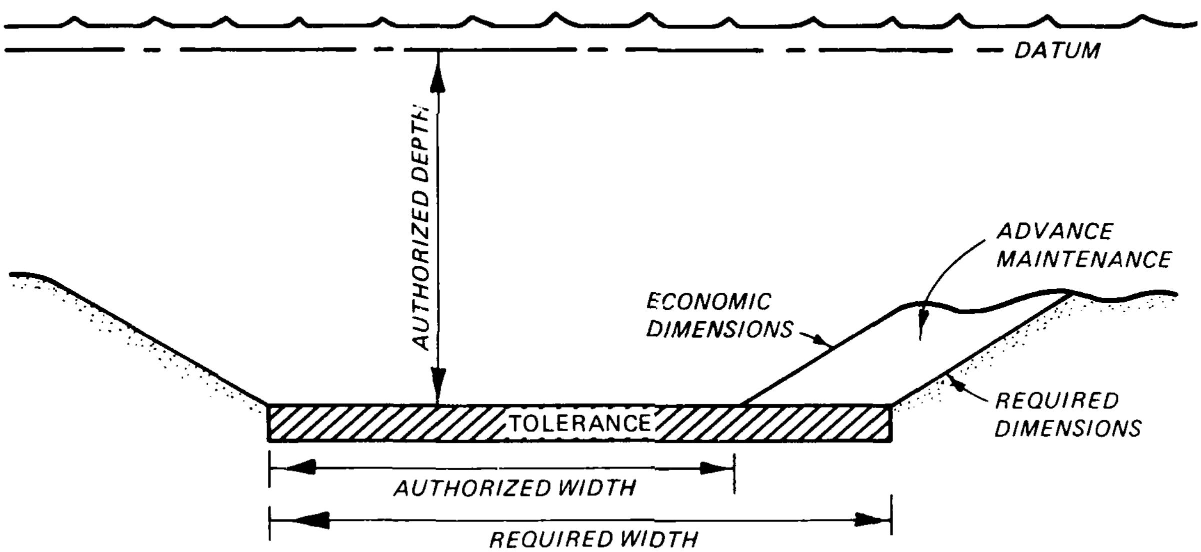


Figure 1. Typical dredged channel cross section without advance maintenance

* A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 3.
** Personal Communication, Commanders, US Army Engineer Divisions.



a. Overdepth form of advance maintenance



b. Overwidth form of advance maintenance

Figure 2. Typical channel cross sections with advance maintenance included

8. Advance maintenance can be used to reduce the required dredging frequency or to increase the percent of time the navigation channel remains at its economic dimensions. The percent of time a channel reach remains navigable at its economic dimensions will be referred in this report as the "depth assurance index." For example, a navigation channel reach that remains navigable at its economic depth 50 percent of the time under a given dredging program would be assigned a depth assurance index of 50.

Objective

9. The objective of this report is to establish guidelines for the use of advance maintenance dredging in entrance channels. These guidelines will be accomplished by evaluating the effects of advance maintenance or channel enlargement (increased depth and/or width) on shoaling characteristics of specific entrance channels on the Atlantic, Gulf, and Pacific coasts. Channel enlargement is included since advance maintenance, when first performed at a particular channel segment, is technically "new work" dredging as it involves the removal of undisturbed material rather than accumulated sediments (Johnson and Marcroft 1965).

Scope

10. The evaluations presented in this report are based on an empirical technique using hydrographic survey maps and historical dredging records obtained from the US Army Corps of Engineers District offices within whose boundaries these projects lie. These project evaluations are presented as an aid in determining the cost effectiveness of advance maintenance and in developing rational criteria for its use in entrance channels.

11. The assessments on the potential for effective application of advance maintenance for each project reported herein are based on hydrographic survey data representing many dredging operations over long periods of time. No attempt was made to analyze other factors which may have affected the shoaling characteristics of individual shoaling periods. Some of the factors which could influence the yearly shoaling phenomena of entrance channels are variability in wave action, littoral currents, and upland freshwater discharge. Instead, a brief description of physical and hydraulic

characteristics is presented before the evaluation of each project.

12. An inventory of advance maintenance projects along with a discussion on existing criteria for the use of advance maintenance was given by Trawle and Boyd (1978). An empirical method developed for the evaluation of advance maintenance effectiveness in estuary channels is given by Trawle (1981). An evaluation of selected advance maintenance projects in estuaries is given by Berger and Boyd (1985).

PART II: EVALUATION OF ATLANTIC COAST PROJECTS

Wilmington Harbor Entrance Channel

Location and description

13. The Wilmington Harbor entrance channel is located near the southern extremity of the Atlantic coast of North Carolina (Figure 3). The harbor is about 100 miles south of Cape Lookout, North Carolina, and 150 miles north of Charleston, South Carolina. The entrance channel is 40 ft* deep and 500 ft wide from deep water in the ocean through Baldhead Shoal Channel to river mile 0 (Figure 4).

14. Cape Fear River is formed in central North Carolina by the confluence of the Deep and Haw Rivers. It flows generally southeast for 198 miles and empties into the Atlantic about 28 miles below Wilmington, North Carolina.

History of improvements at the entrance

15. In 1913 an entrance channel was dredged to a depth of 26 ft and a width of 400 ft. The depth was increased to 30 ft in 1926. By 1949 the channel was 32 ft deep and 400 ft wide (US Army Engineer District (USAED), Wilmington, 1976).

16. Between 1956 and 1958 the entrance was deepened again. The channel dimensions then became 35 by 400 ft. The entrance channel was enlarged to its present dimensions of 40 ft deep and 500 ft wide between 1970 and 1973. There are no jetties at the entrance (USAED, Wilmington, 1976).

Hydraulic characteristics

17. Mean tidal range is 4.5 ft on the ocean bar and 4.3 ft at Baldhead Island (river mile 0). The spring range is 5.1 ft at the bar and 4.9 ft at Baldhead Island. Maximum flood currents at Baldhead Island are about 4 ft/sec and maximum ebb currents are about 5 ft/sec (USAED, Wilmington, 1976).

18. Freshwater inflow into the lower Cape Fear River is partially regulated by a series of locks and dams on the upper portion of the river. The average freshwater discharge into Wilmington Harbor has been estimated at 6,400 cfs. The lower portion of the estuary is classified as partly mixed

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* All depths in this part are referred to mean low water (mlw).

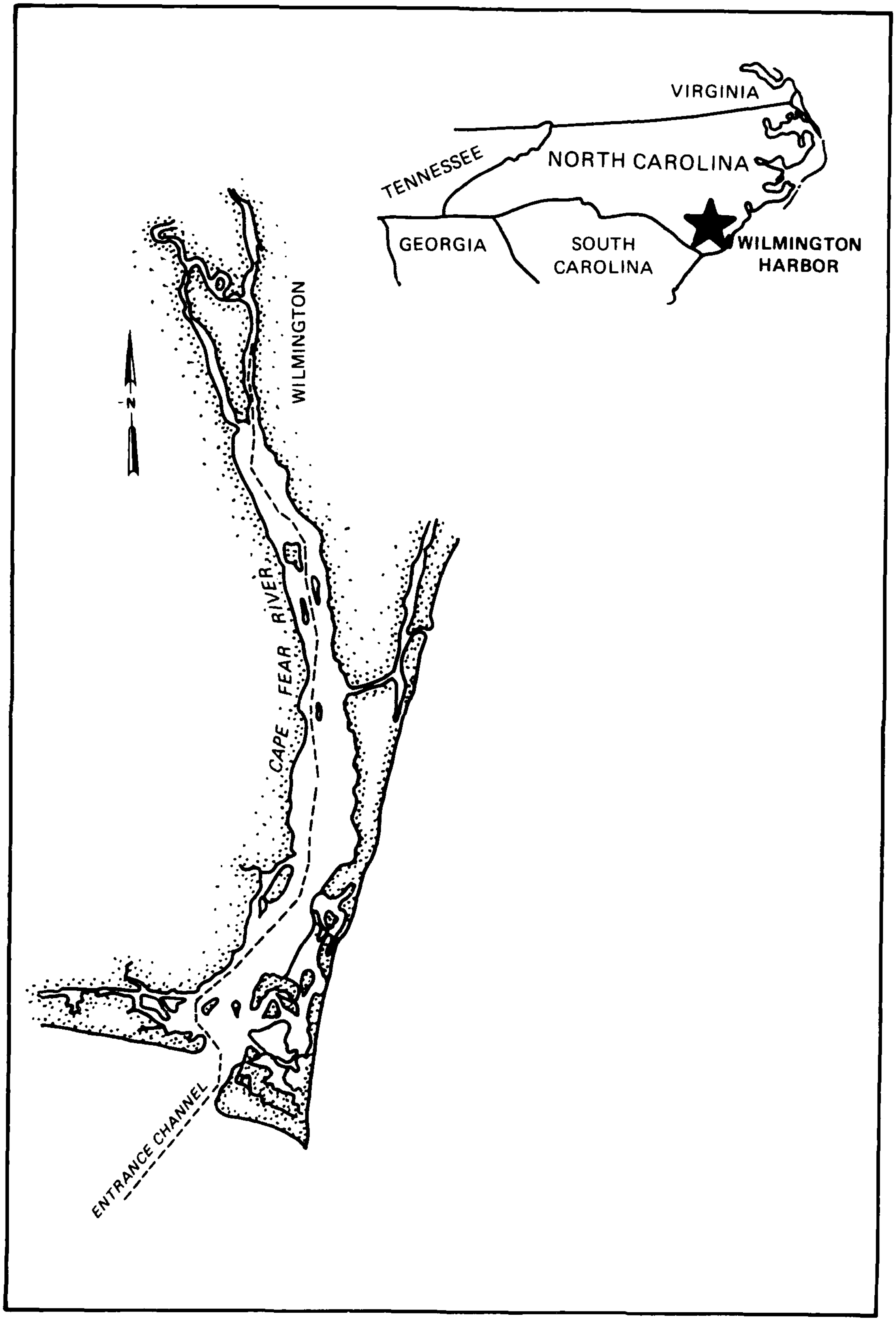


Figure 3. Wilmington Harbor, North Carolina

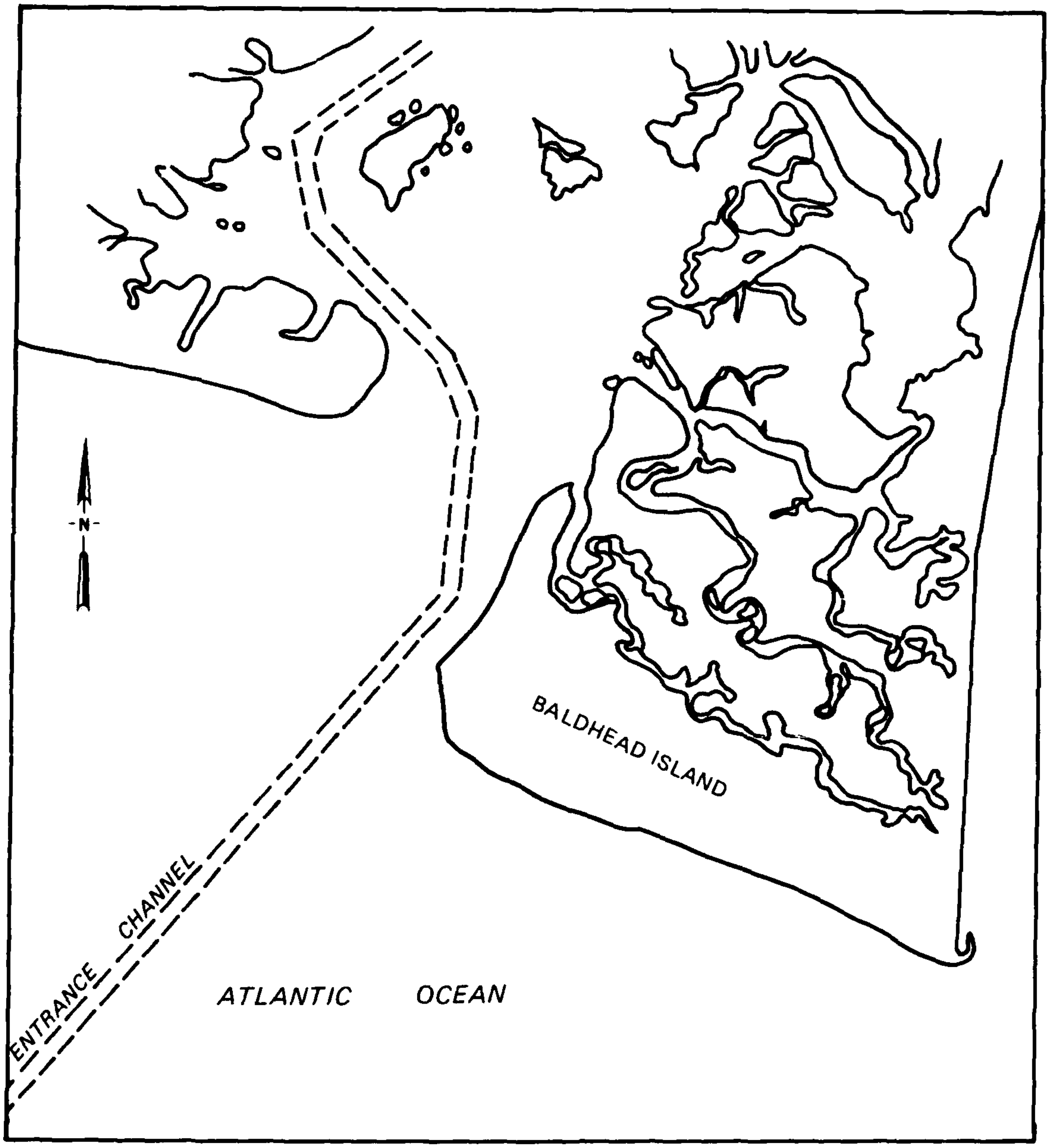


Figure 4. Wilmington Harbor, North Carolina, entrance channel

with bottom salinities being one-half to three time greater than surface salinities (USAED, Wilmington, 1976).

<u>Shoaling characteristics</u>

19. Shoal material in the entrance is composed of sand, moved into the channel by wave action and littoral currents, and flocculated silt and clay particles that have been carried in suspension downriver. Based on sediment sample information on the "Before Dredging" survey sheets, sand is the predominant shoal material from sta 0+000 (Baldhead) to sta 10+000. From about sta 10+000 seaward, the predominant material is clay (Figure 5).

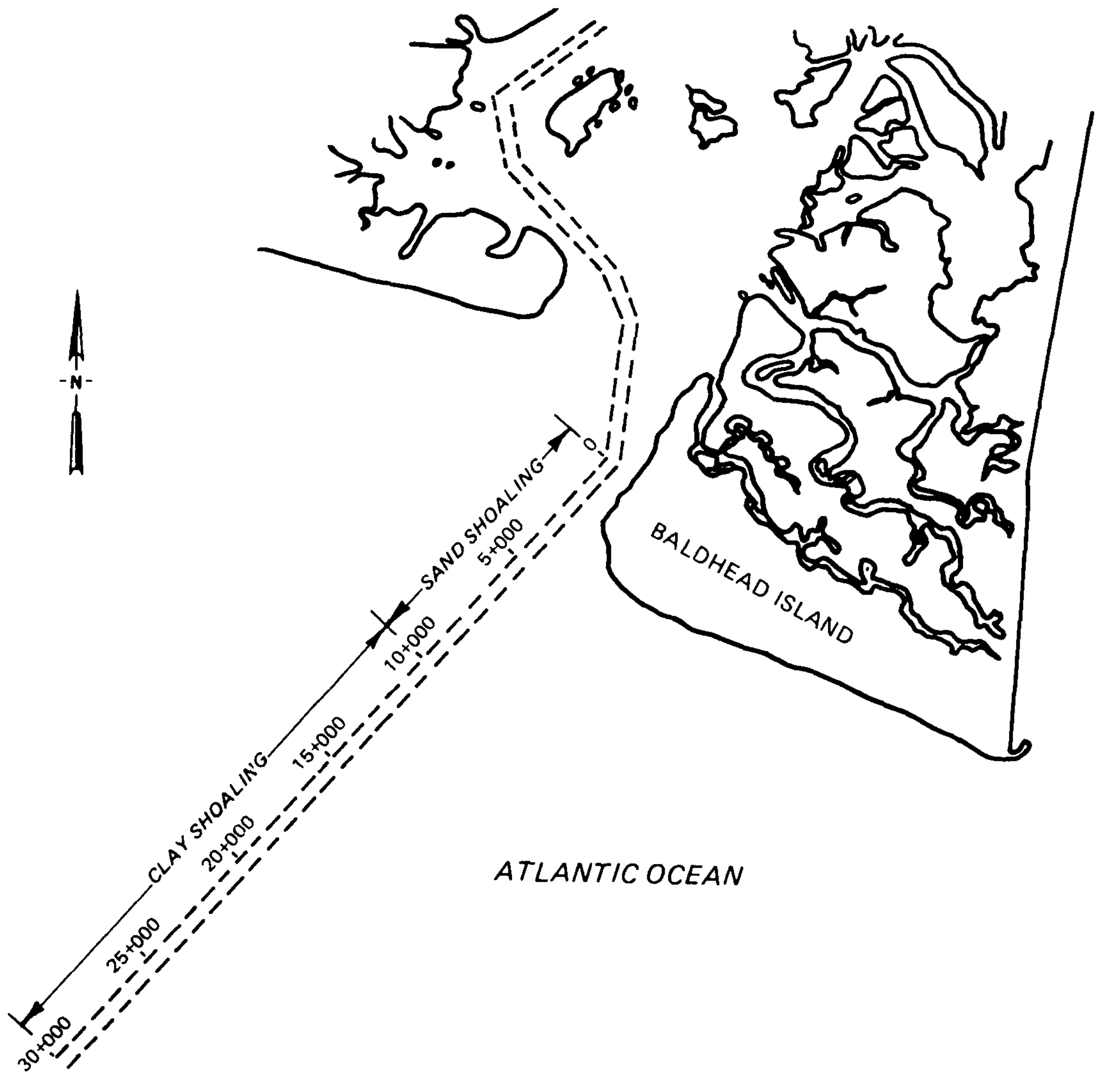


Figure 5. Wilmington Harbor, North Carolina, entrance channel sediment composition

Results of project evaluations

20. Results discussed here are based on the analysis of data extracted from hydrographic survey maps, obtained from USAED, Wilmington. Comparing shoaling volumes and infill rates of the existing (40- by 500-ft) project with those of the previous (35- by 400-ft) project should indicate the potential effectiveness, if any, of advance maintenance dredging in this entrance channel.

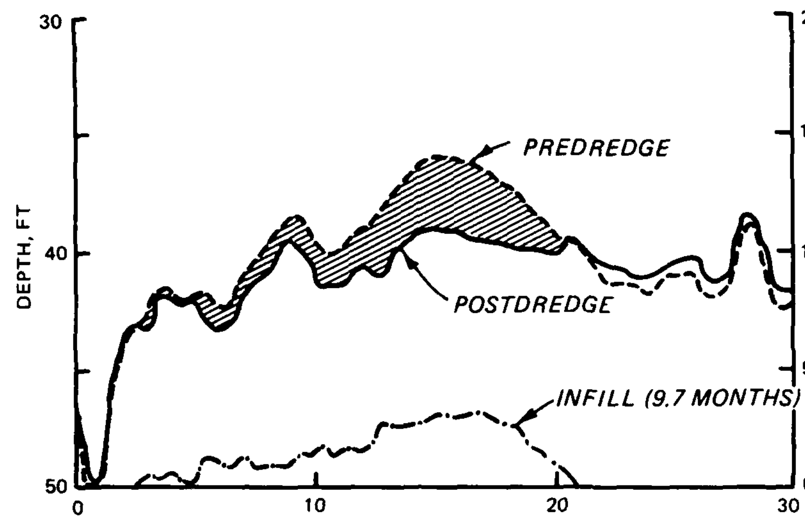
21. Seven predredge and postdredge surveys conducted between August 1959 and November 1967 were used to determine representative shoaling volumes and infill rates for the 35-ft-deep channel. For the 40-ft-deep project, nine predredge and postdredge surveys conducted between July 1971 and October 1982 were used.

22. Tables 1 and 2 list the average predredge and postdredge depths at 45 channel ranges from sta 0+000 seaward to sta 22+000 for each of the seven shoaling periods for the 35-ft project. The ranges are 500 ft apart, and the northwest and southeast halves of the channel were examined separately. Tables 3 and 4 list similar data for each of the nine shoaling periods for the 40-ft-deep project. These tables also list the mean predredge and postdredge depths and average infill in feet over the periods of interest for each range.

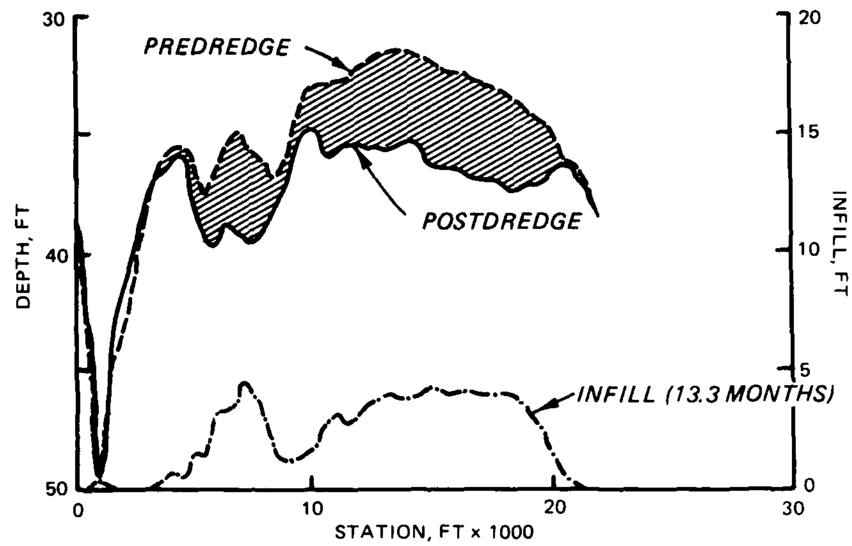
23. Representative infill profiles for both projects, developed from mean depths in Tables 1-4, are shown for the northwest half of the channel in Figure 6 and for the southeast half of the channel in Figure 7. For both projects, most of the channel shoaling occurred between sta 10+000 and 20+000. The sediment sample information on the "Before Dredging" survey sheets characterized the material in this area as being predominantly clay.

24. The infill curves in Figures 6 and 7 were integrated to determine corresponding volumes of material to quantitatively establish the impact of channel enlargement on annual shoaling volumes. Results of the calculations are shown in the following tabulation:

Channel		Annual Shoaling Volume 1,000 cu yd 35-ft Project	40-ft Project	Percent Increase
Northwest half		333	336	1
Southeast half		352	384	9
	Total	685	720	5

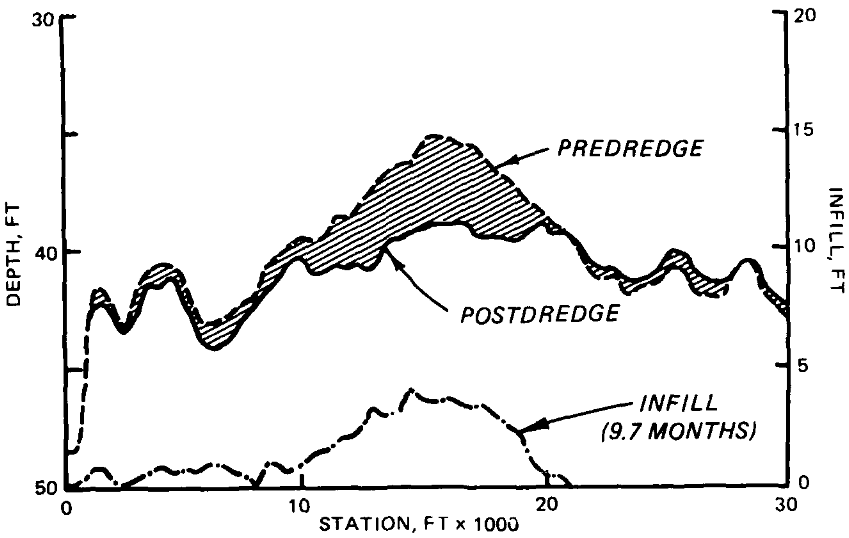


a. 40-ft project

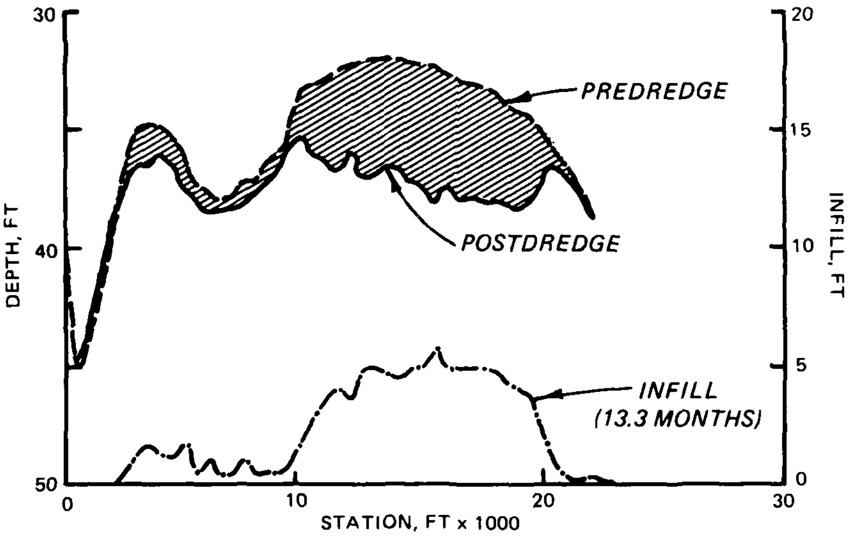


b. 35-ft project

Figure 6. Infill profiles along the northwest half of the Wilmington Harbor entrance channel



a. 40-ft project



b. 35-ft project

Figure 7. Infill profiles along the southeast half of the Wilmington Harbor entrance channel

25. Infill patterns for two typical shoaling periods of each project are shown in Figures 8-11. The 1961 and 1967 shoaling patterns for the 35-ft-deep project are shown in Figures 8 and 9 while the 1976 and 1982 shoaling patterns for the 40-ft-deep project are shown in Figures 10 and 11. While the infill periods for the 40-ft project average only about 9 months and those of the 35-ft project average about 13 months, only a small increase of 5 percent in shoaling rate was indicated. These data suggest that this project has the potential for the effective application of advance maintenance.

Lynnhaven Inlet Entrance Channel

Location and description

26. The Lynnhaven Inlet entrance channel is located on the Chesapeake Bay shore of Virginia (Figure 12). It is 5 miles west of Cape Henry and 10 miles east of Norfolk, Virginia. The inlet connects Lynnhaven Roads, a part of Chesapeake Bay, with a network of inland waters in the northern half of the city of Virginia Beach.

27. The existing project at the entrance provides for a navigation channel 10 ft deep and 150 ft wide from Chesapeake Bay to a mooring and turning basin 10 ft deep, 1,250 ft long, and 700 ft wide in Lynnhaven Bay (Office, Chief of Engineers (OCE) 1983). There are no jetties at the entrance.

History of improvements at the entrance

28. The existing project was constructed between July 1965 and January 1966 (OCE 1977). Periodic maintenance dredging, including overdepth and overwidth advance maintenance, has been required to restore authorized dimensions. No change in authorized dimensions has occurred.

Hydraulic characteristics

29. Tides at Lynnhaven Inlet are semidiurnal. Mean tidal range at mile 0 (Lynnhaven Inlet Bridge) is 3.0 ft. Current velocities at Lynnhaven Roads are estimated to be generally less than 2 ft/sec for both flood and ebb tides (Committee on Tidal Hydraulics (CTH) 1971).

30. All of the waters within Lynnhaven Inlet are brackish and subject to the action of tides. Salinities vary from 20 to 25 ppt (CTH 1971).

Shoaling characteristics

31. Shoaling material is primarily sand. Shoaling in the entrance

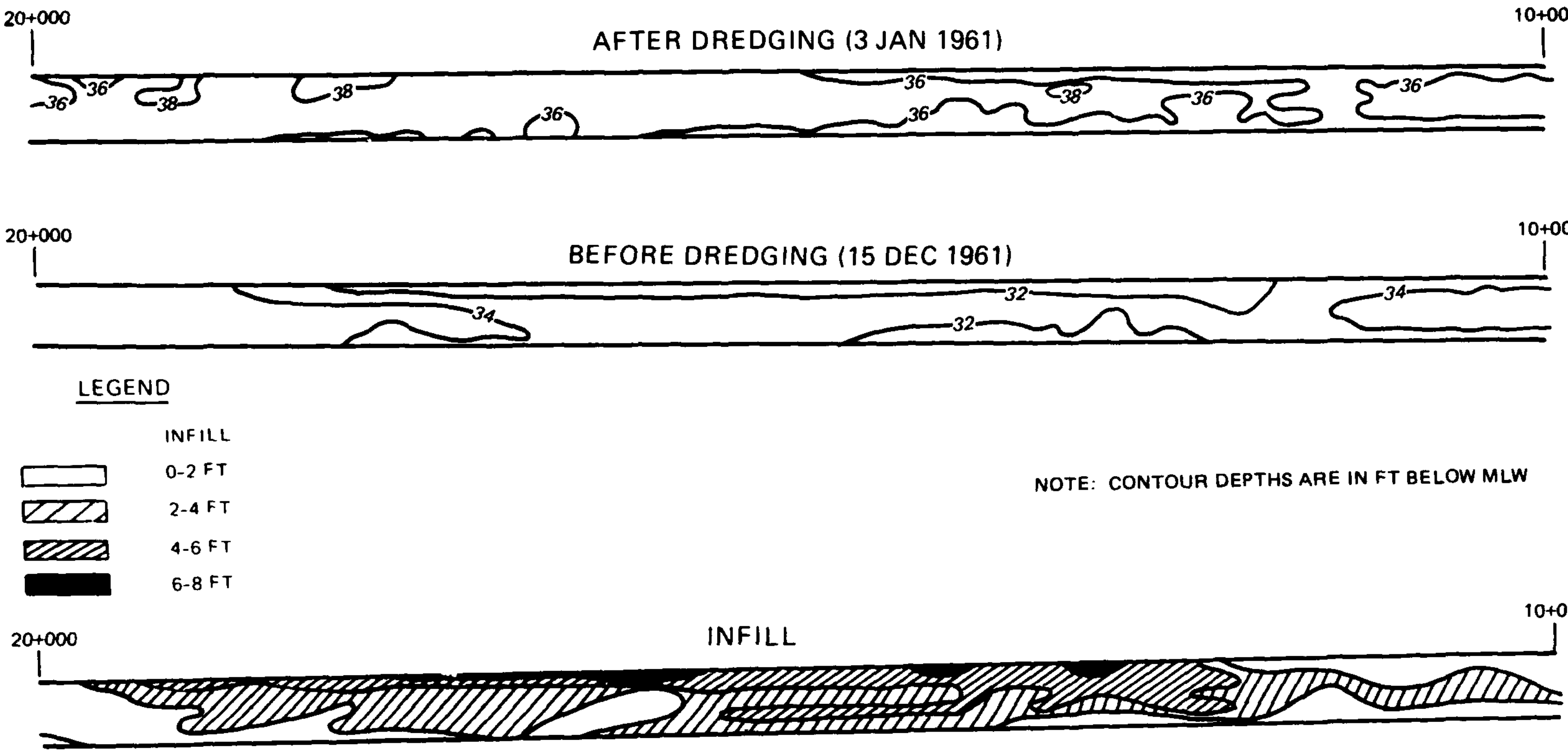


Figure 8. 1961 shoaling pattern in Wilmington Harbor entrance channel, 35-ft project

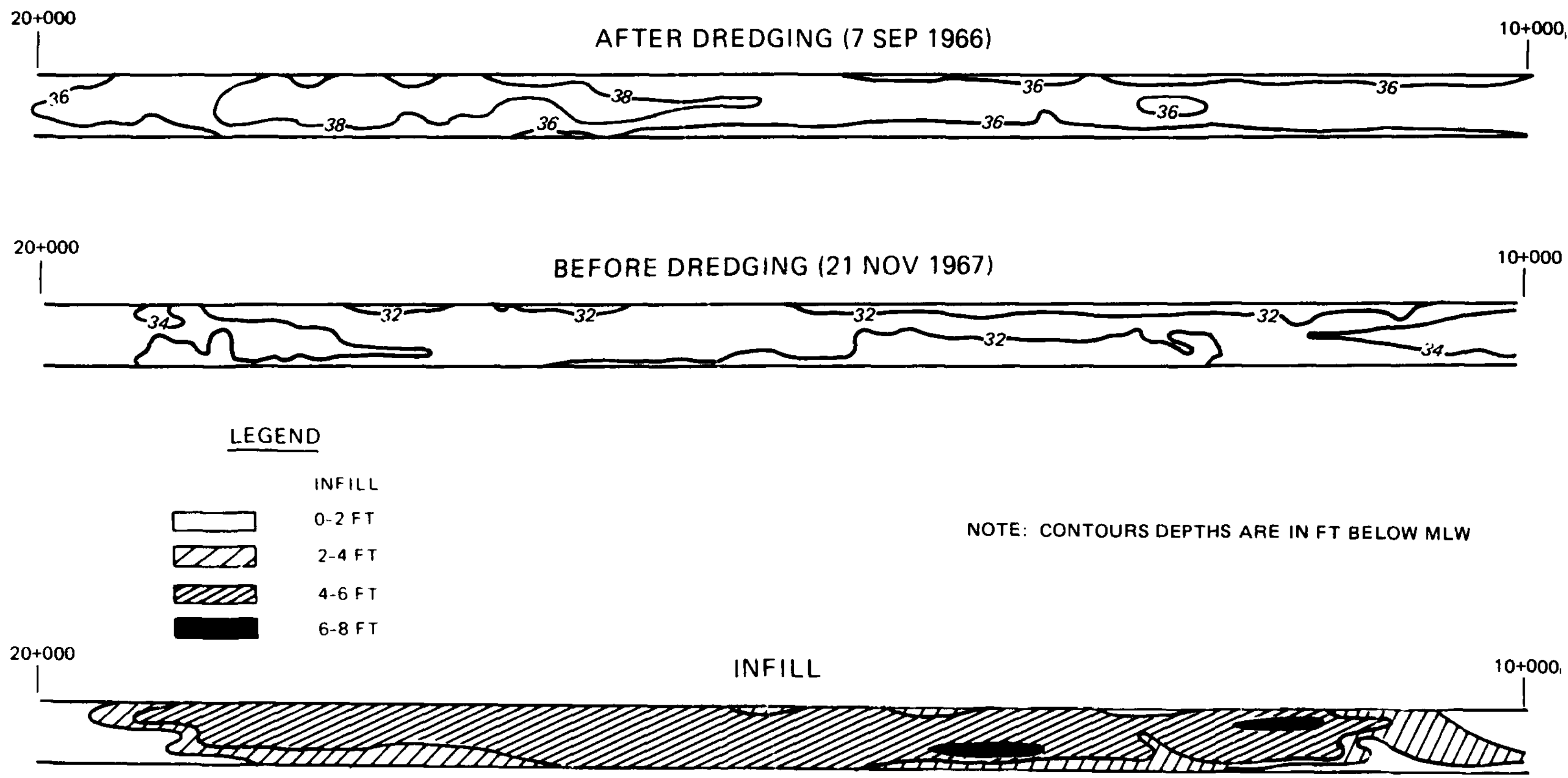


Figure 9. 1966-1967 shoaling pattern in Wilmington Harbor entrance channel, 35-ft project

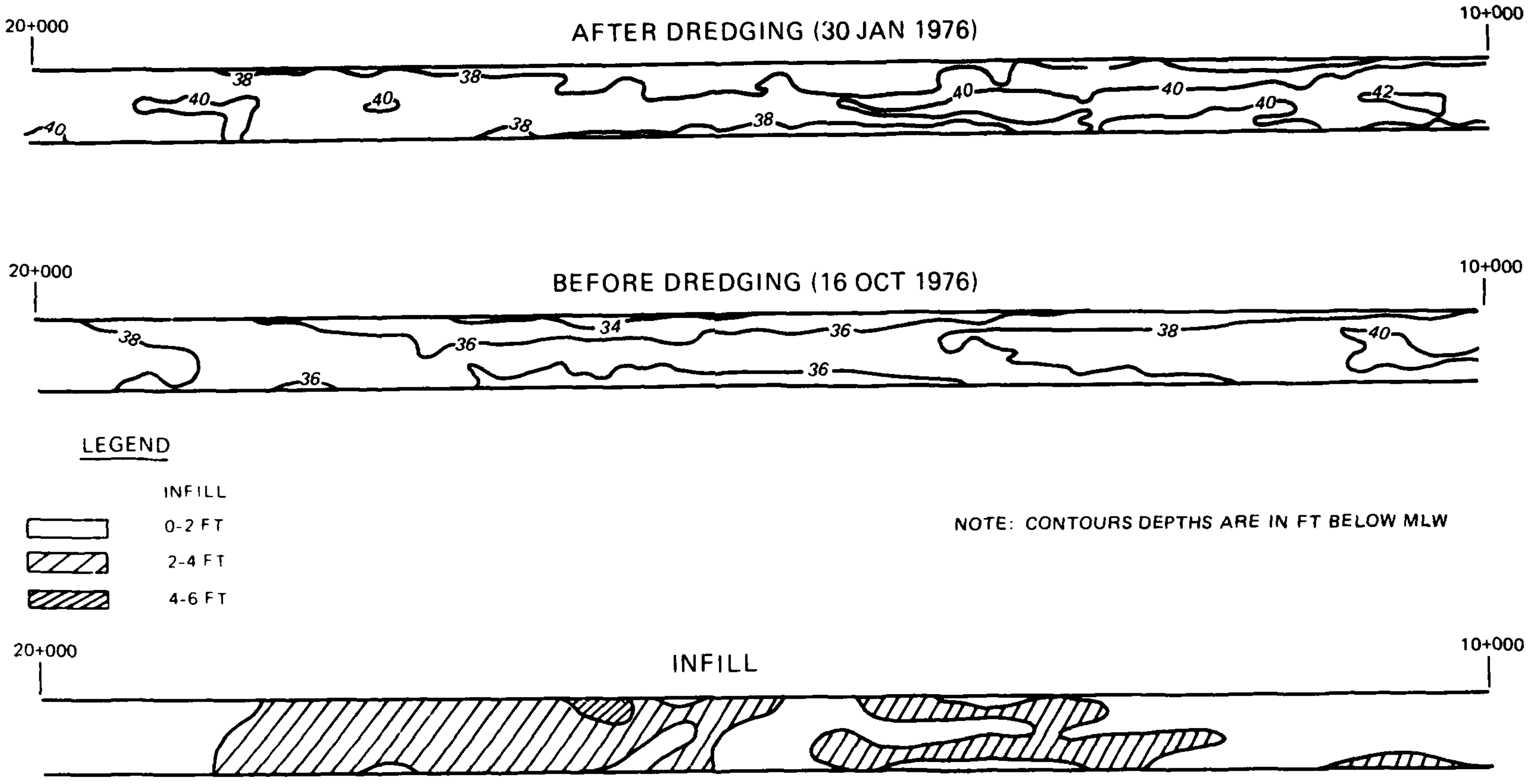


Figure 10. 1976 shoaling pattern in Wilmington Harbor entrance channel, 40-ft project

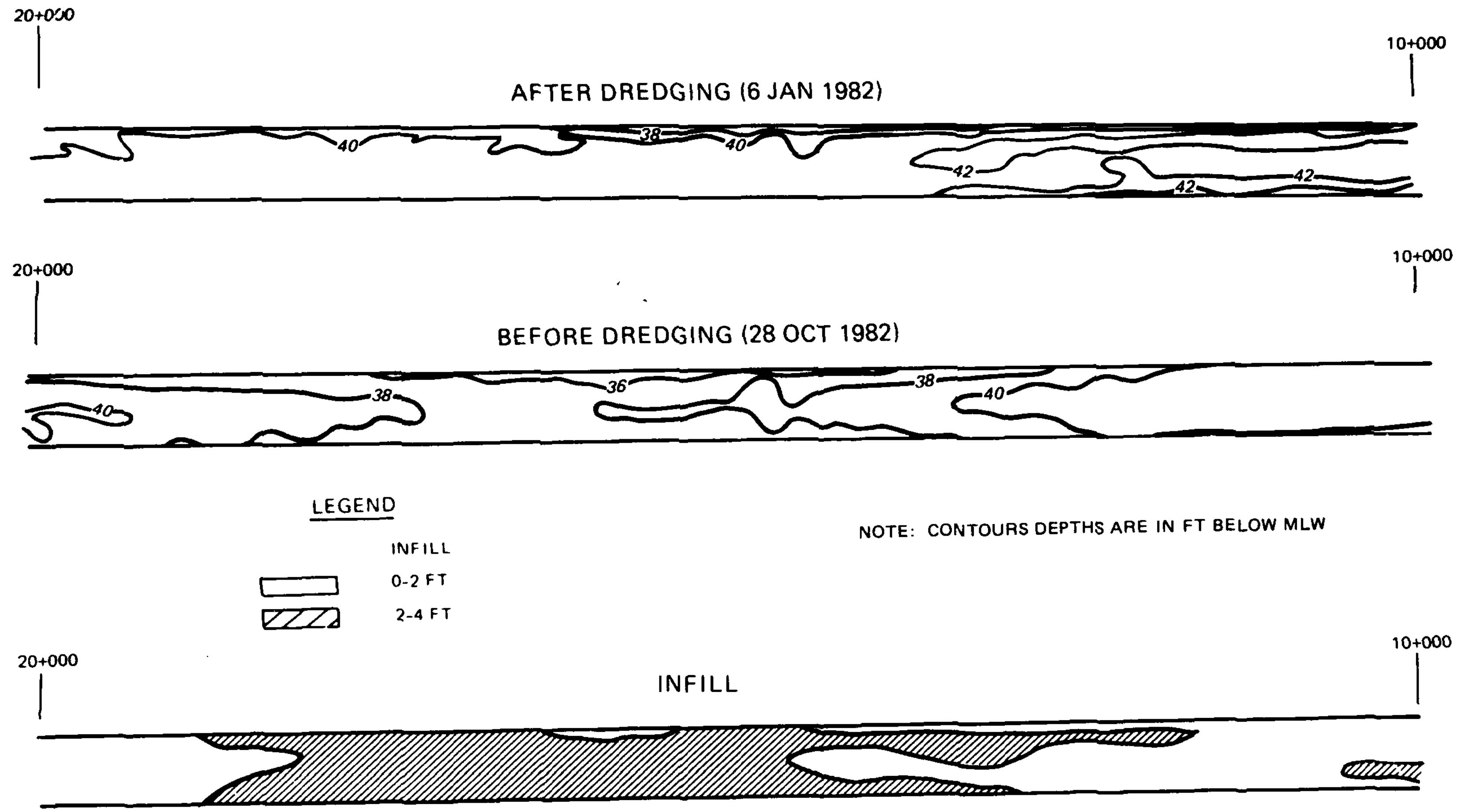


Figure 11. 1982 shoaling pattern in Wilmington Harbor entrance channel, 40-ft project

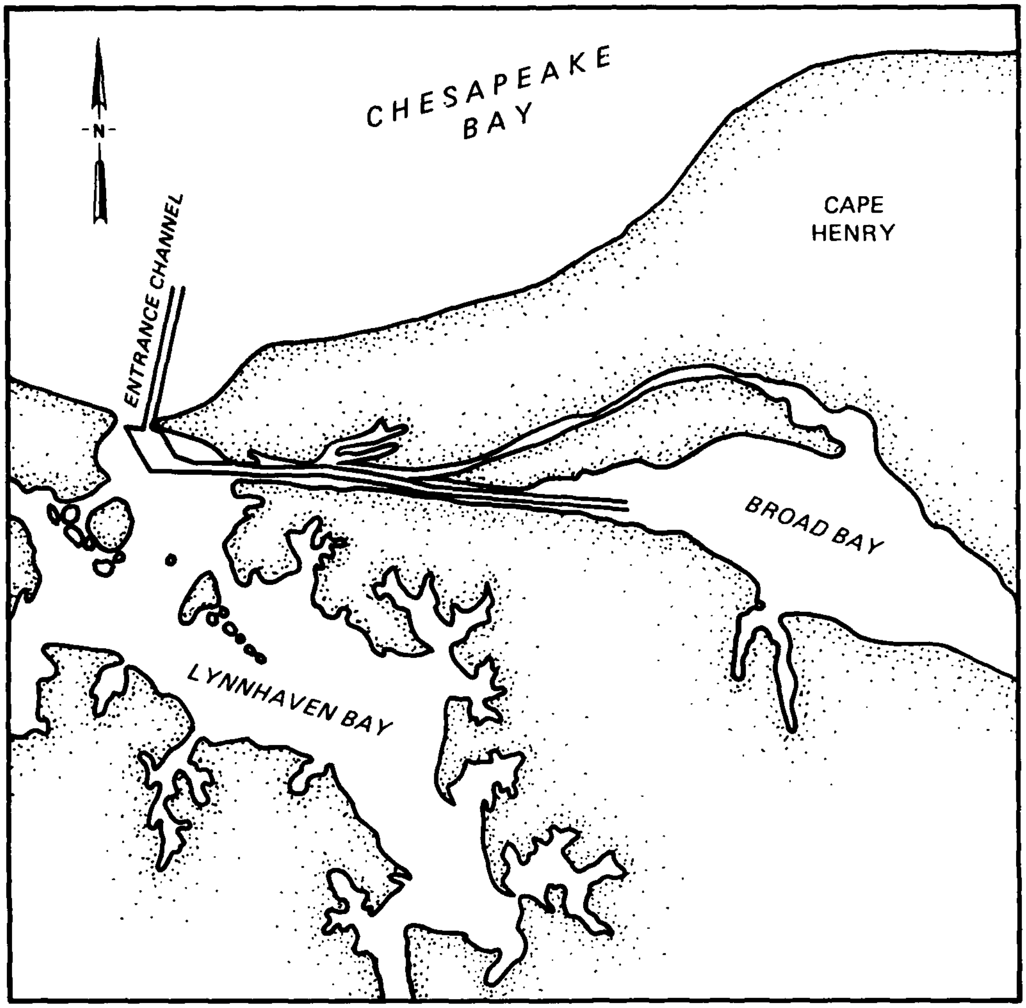


Figure 12. Lynnhaven Inlet, Virginia

channel is attributed to the encroachment of a sandbar located west of the channel (CTH 1971).

Results of project evaluation

32. The original channel layout, as described in the predredge survey of August 1965 is presented in Figure 13a. Required maintenance dredging included 20 ft of overwidth advance maintenance on each side of the channel. By June 1968, both the alignment of the channel and the application of overwidth advance maintenance had been changed (Figure 13b). The outer portion of the channel was realigned in an attempt to reduce maintenance dredging requirements in that area of the project. Also, overwidth advance maintenance was increased to 50 ft along the channel reaches which had experienced the heaviest shoaling. In November 1970, overwidth advance maintenance was

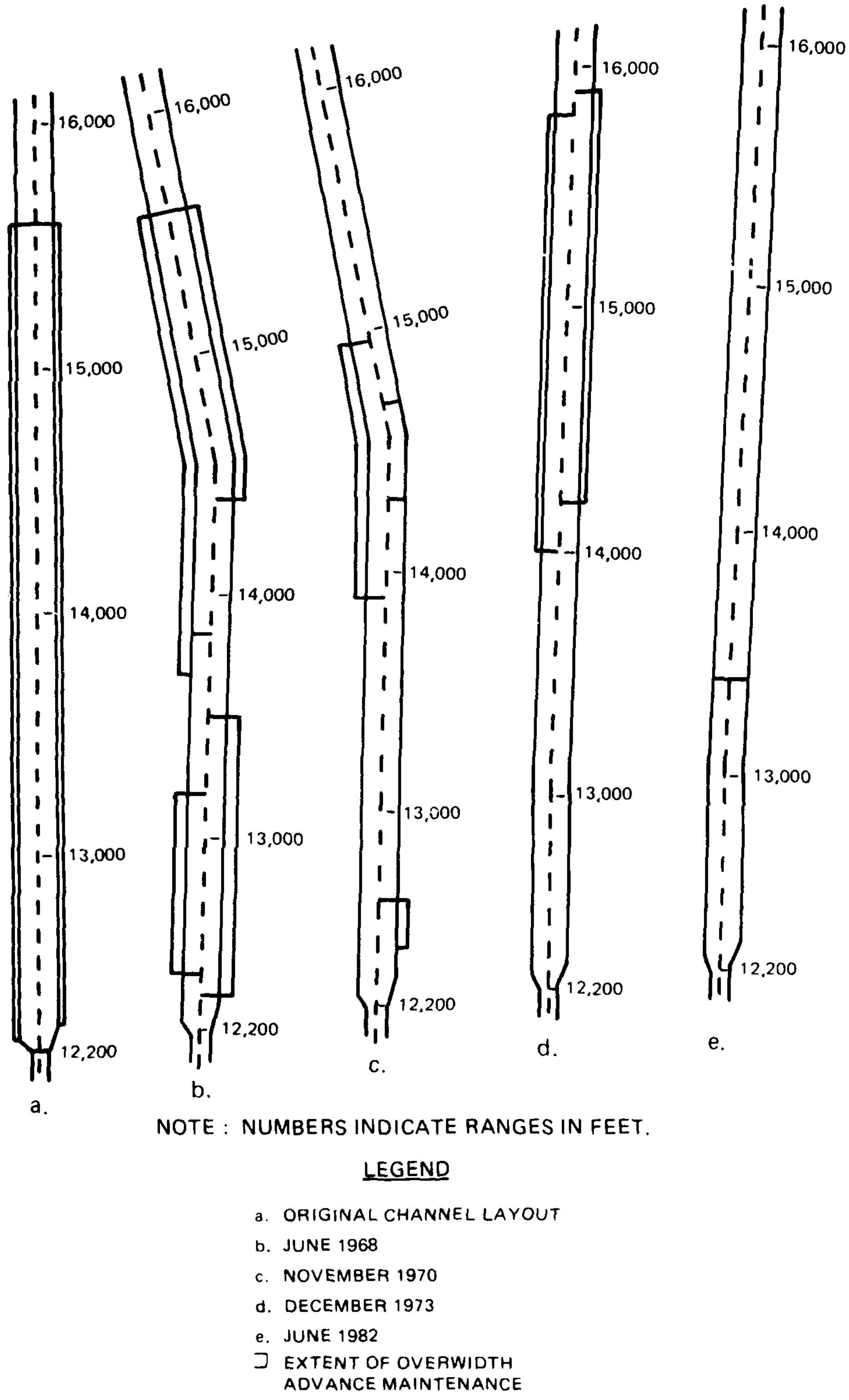


Figure 13. Lynnhaven Inlet channel alignments from 1965 to 1984

eliminated except at the two sections as shown in Figure 13c. Channel alignment and overwidth advance maintenance were again changed in December 1973. The channel was aligned and 25 ft of overwidth advance maintenance was applied as shown in Figure 13d. Finally, in June 1982, all overwidth advance maintenance was discontinued (Figure 13e). In addition to the various applications of overwidth advance maintenance, all regular maintenance operations included 2 ft of overdepth dredging.

33. Observed infill rates, calculated from hydrographic survey sheets, are summarized in Table 5. Based on the data presented in this table, the channel alignment and the overwidth dredging procedure employed between November 1970 and December 1973 resulted in the lowest average annual infill rate. However, the frequency of the changes in channel alignment and overwidth advance maintenance prohibit an accurate assessment of the effect of these changes on shoaling volumes and rates at Lynnhaven Inlet. The project was included in this report since it represents a concerted effort to minimize maintenance dredging by trial and error through various applications of overwidth dredging and channel alignment.

Savannah Harbor Entrance Channel

Location and description

34. Savannah Harbor is located at the northern corner of the Atlantic coast of Georgia. The entrance is 75 statute miles south of Charleston Harbor, South Carolina, and 70 statute miles north of Brunswick Harbor, Georgia.

35. The existing navigation project at the entrance consists of a 40- by 600-ft-wide channel from deep water in the ocean across Tybee Bar, Tybee Roads and Tybee Knoll, to river mile 0, mouth of the Savannah River (sta 0+000). Training walls at Oyster Bed Island north of the channel and Cockspur Island south of the channel extend from sta 0+000 seaward for approximately 12,000 ft (Figure 14).

History of improvements at the entrance

36. A channel across the bar, navigable at high water for vessels of 22-ft draft, was completed by 1888 (OCE, 1971). The project was enlarged in 1930 to 30 ft deep and 500 ft wide. In 1951 the channel was deepened to

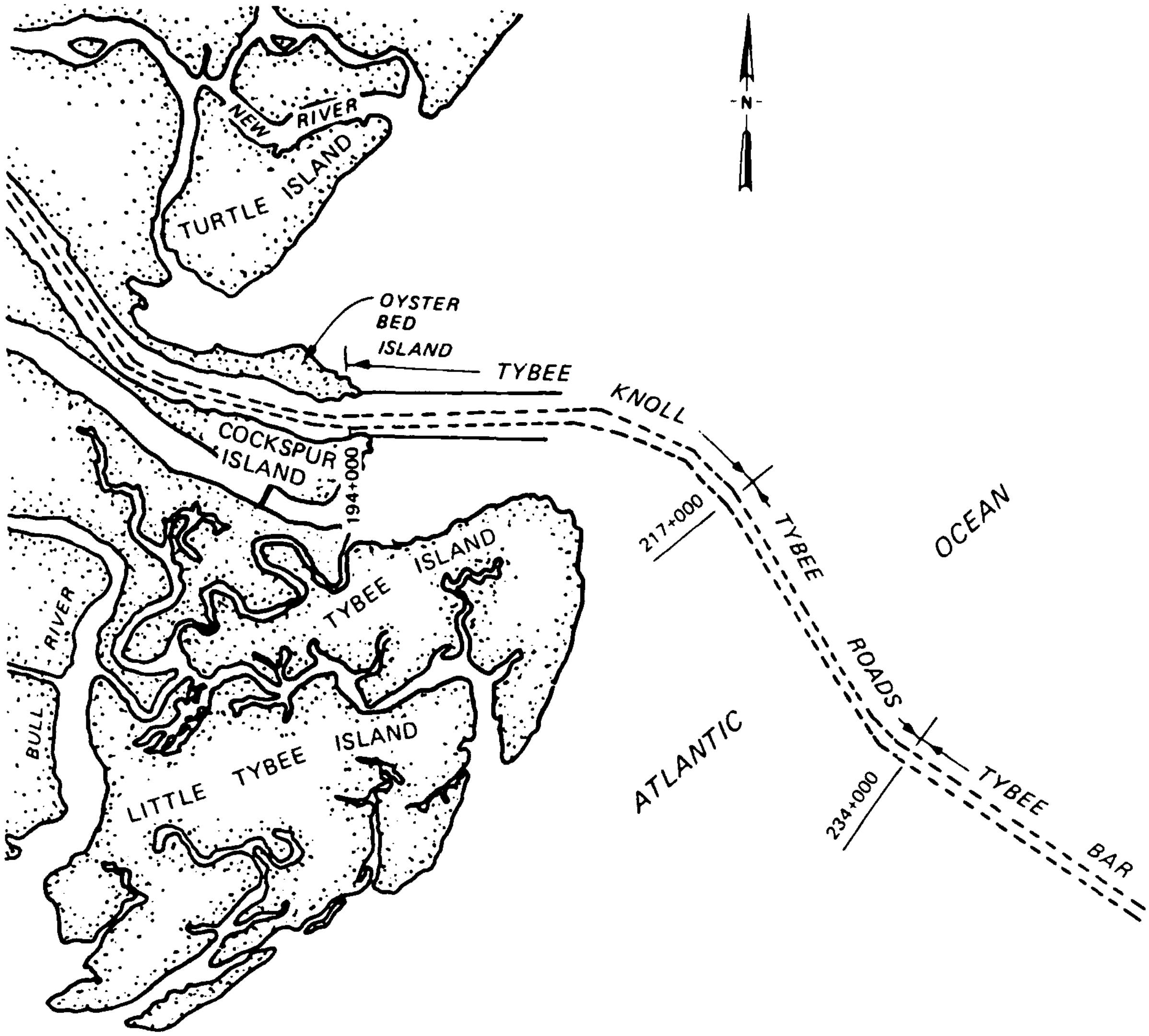


Figure 14. Savannah Harbor entrance channel

36 ft. The existing dimensions (40 by 600 ft) of the entrance channel were completed in 1978 (OCE 1983).

Hydraulic characteristics

37. The tides at Savannah Harbor are semidiurnal. The river is tidal for about 50 miles upstream of the mouth. Mean range of tide at the mouth of the river is 6.9 ft. The spring range is 8.1 ft with a tidal prism of 3.1 billion cu ft (CTH 1971). Maximum flood currents at Tybee Roads are about 2.7 ft/sec and maximum ebb currents are about 4.4 ft/sec (Jarrett 1976).

38. Savannah River has a drainage area of 10,579 square miles. The water in the upper portion of the harbor is fresh while that at the mouth is

essentially seawater. The degree of mixing of salt and fresh water and the upstream extent of saltwater intrusion vary with the range and elevation of tides and the amount of freshwater discharge (CTH 1971).

Shoaling characteristics

39. Shoal material in the entrance channel (Tybee Knoll, Tybee Roads, and Tybee Bar) is predominantly composed of coastal sand moved into the channel by wave action and littoral currents. Also, during river freshets, flocculated silt and clay particles that have been carried in suspension downstream are also deposited in the entrance channel.

Results of project evaluation

40. Hydrographic surveys obtained from USAED, Savannah, were used to compare average annual infill rates and shoaling volumes of the existing 40- by 600-ft Savannah entrance channel to those of the previous 36- by 500-ft project. Two shoaling periods between May 1970 and November 1971 were examined for the 36-ft-deep channel. Two shoaling periods between January 1979 and October 1981 were examined for the 40-ft-deep channel. The portion of the entrance known as Tybee Knoll (sta 194+000 to 217+000), and the portion known as Tybee Roads (sta 217+000 to 234+000) were analyzed separately (Figure 14). These two reaches represent the portion of the entrance channel with the highest shoaling rates.

41. The shoaling volume results for both the Tybee Knoll and Tybee Roads reaches of the entrance channel are summarized as follow:

	Average Annual Shoaling Volumes 1,000 cu yd		
Channel Reach	36- by 500-ft Project	40- by 600-ft Project	Percent Increase
Tybee Knoll	428	459	7
Tybee Roads	285	314	10

42. Although these data are not statistically significant, they do suggest that the deepened (from 36 to 40 ft) and widened (from 500 to 600 ft) channel traps only slightly more sediment along the Tybee Knoll and Tybee Roads sections than the previous channel. If one accepts this conclusion, then advance maintenance along Tybee Knoll and Tybee Roads has potential for improving navigation conditions (greater depth assurance index) without any major cost increases, since its application should not result in any appreciable increases in shoaling rates.

PART III: EVALUATION OF GULF COAST PROJECTS

Gulfport Harbor Entrance Channel

Location and description

43. Gulfport Harbor is located on the Mississippi Sound in southeastern Mississippi (Figure 15). It is about 90 miles by water west of Mobile Bay, Alabama, and 78 miles via the Gulf Intracoastal Waterway east of New Orleans, Louisiana.

44. As shown in Figure 15, the existing project consists in part of a 32-ft-deep* by 300-ft-wide channel about 8 miles long across Ship Island Bar, a 30-ft-deep by 220-ft-wide channel through Mississippi Sound (the portion evaluated in this study), and an anchorage basin 30 ft deep, 1,320 ft wide, and 2,640 ft long at Gulfport (CTH 1971).

45. Mississippi Sound is a relatively shallow body of water extending about 80 miles from Mobile Bay on the east to Chandeleur Sound and Lake Borgne on the west. It varies in width from 7 to 15 miles between the mainland coast on the north and a line of five barrier islands to the south which separates it from the Gulf of Mexico. The barrier islands are 6 to 12 miles long and average about a half mile in width. They are separated from one another by 3 to 6 miles of open water, most of which overlies a fairly shallow sand bottom or bar (US 96th Congress, 1st Session (US 96th Congress 1979)).

History of improvements at the entrance

46. A 19-ft-deep by 300-ft-wide channel from Ship Island to Gulfport was completed in 1902. In 1923 a 220-ft-wide segment of the 300-ft-wide channel was deepened from 19 to 23 ft. In 1934 the channel through Mississippi Sound was deepened to a depth of 26 ft. The existing channel at a depth of 30 ft and width of 220 ft was constructed in 1950 (US 96th Congress 1979).

Hydraulic characteristics

47. Tides at Gulfport are diurnal with a normal range of 1.75 ft and an extreme range of about 3.5 ft. Elevations are greatly affected by the force and direction of the wind. Flood tide currents enter the sound between the barrier islands and move in a northwesterly direction closely paralleling the

* All depths in this part are referred to mean low water (mlw).

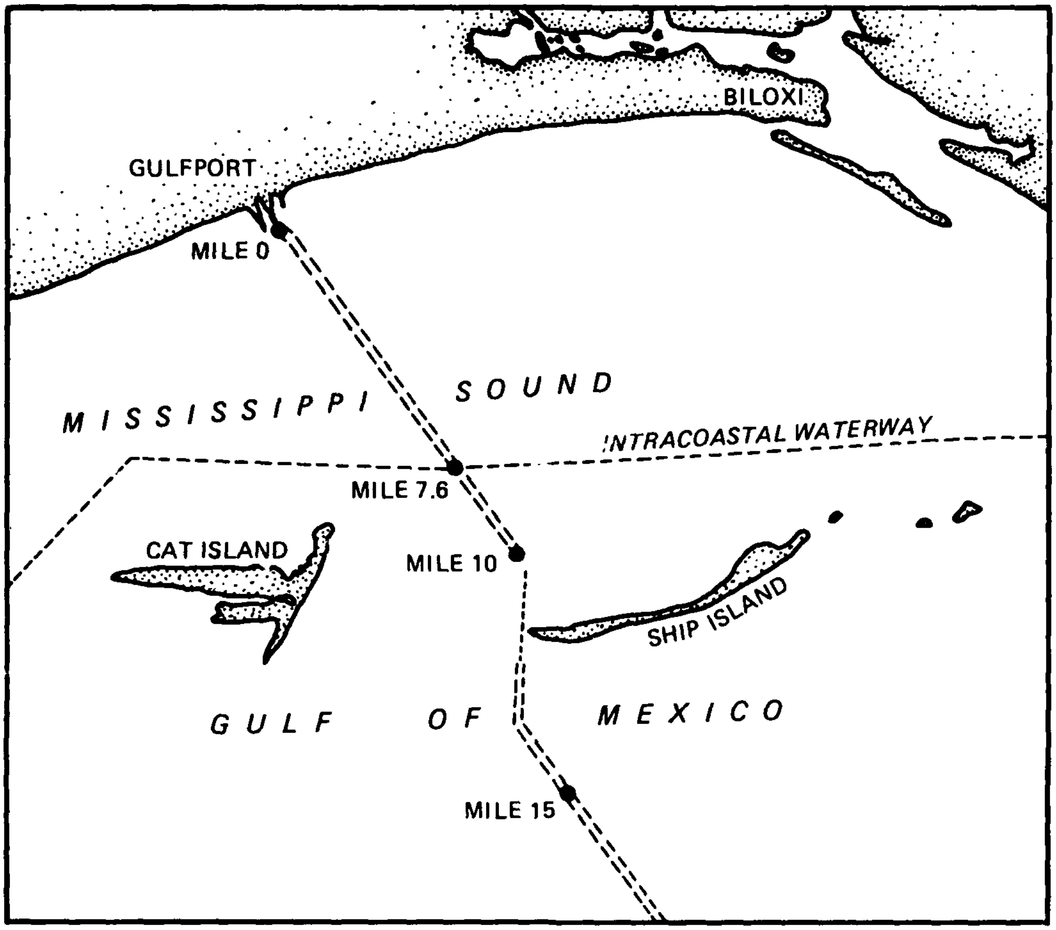


Figure 15. Gulfport Harbor location map

ship channel. As the currents approach the shore, they turn in a more westerly direction until reaching the inshore end of the ship channel where they turn parallel to the shore and nearly perpendicular to the channel. During ebb tide these currents reverse. Maximum velocity of the tidal currents in Mississippi Sound under normal weather conditions is about 0.8 to 1.2 ft/sec (CTH, 1971).

48. No freshwater streams enter the sound at Gulfport to dilute the saline water. However, salinity patterns of the sound are subject to seasonal and annual variations. In general, lower surface salinities are encountered

at the west end of the sound where large quantities of fresh water enter from the Pearl River and Lake Pontchartrain. Higher salinity occurs where gulf currents pass between the barrier islands and extend up into the estuarine systems comprising Mississippi Sound (US 96th Congress 1979).

Shoaling characteristics

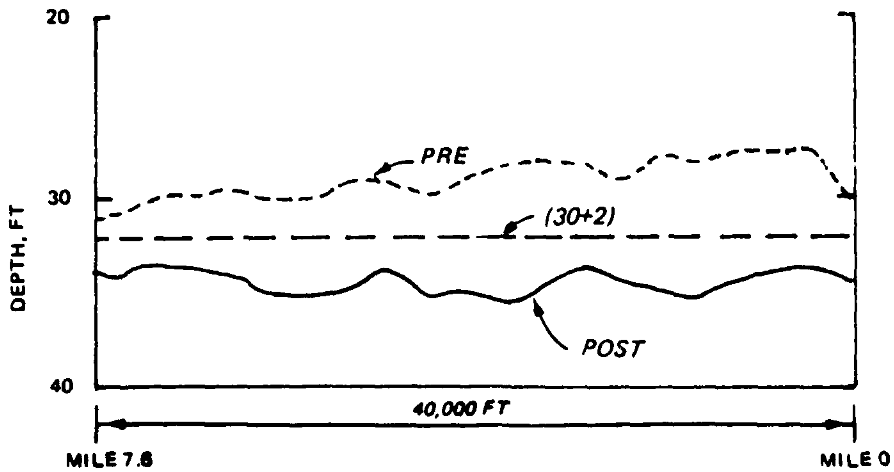
49. The westward movement of a slow longshore current in Mississippi Sound is sufficient to cause a gradual westward drift of sand-size sediments. Silt and clay muds are the dominant sediments in much of the central portion of the sound. Gulfport Ship Channel bisects an area of approximately 32,000 acres of these silt and clay sediments. During periods of high runoff, suspended sediments moving westward from Mobile Bay and the Pascagoula River areas reach waters moving eastward from the Pearl River area and tend to accumulate in the immediate area of Gulfport (USAED, Mobile 1976).

Results of project evaluation

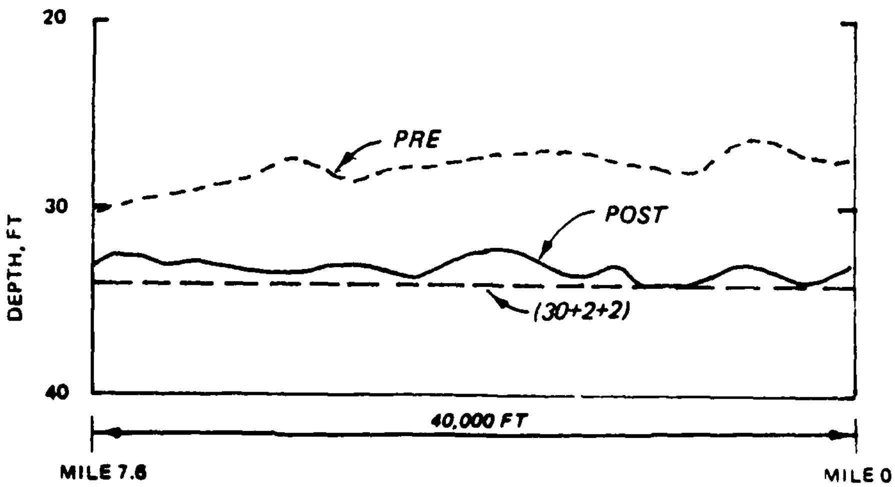
50. Hydrographic survey maps were obtained from USAED, Mobile. Six shoaling periods between October 1974 and September 1982 were examined. According to information on the survey sheets, maintenance dredging operations in 1976, 1977, 1979, and 1981 were designed for depths of 30 ft plus 2 ft of dredging tolerance, while those of 1974 and 1980 were designed for depths of 30 ft plus 2 ft of advance maintenance plus 2 ft of dredging tolerance. In this report these dredging operations are referred to as the without-advance-maintenance and the with-advance maintenance projects, respectively. Approximately 7-1/2 miles of the sound channel immediately south of the anchorage basin at Gulfport were examined, since there were not sufficient data on the lower 3-1/2 miles of the channel to conduct an evaluation.

51. Table 6 lists average predredge and postdredge depths across 21 ranges between sta 0+500 and 40+500 for each of the shoaling periods as well as the mean predredge and postdredge depths for the entire period at each range. The without-advance-maintenance and the with-advance-maintenance projects were examined separately.

52. From the mean depths in Table 6, average predredge and postdredge channel profiles were constructed (Figure 16). As can be seen from these profiles, the average postdredge depth for the channel without advance maintenance was actually about the same as the average postdredge depths for the channel with advance maintenance. This observation means that the effectiveness of advance maintenance cannot be determined directly from these data,



a. 2-ft dredging tolerance



b. 2-ft advance maintenance + 2-ft dredging tolerance

Figure 16. Gulfport Harbor channel profiles, 30-ft project

since advance maintenance was actually applied to all dredging activities even though the dredging specifications did not require it.

53. The detailed depth and infill patterns for the five shoaling periods in 1974, 1976, 1977, 1979, and 1980 are shown schematically in

Figures 17-21. As can be seen from the infill patterns, the shoaling is typically not uniform across the channel width, but distributed so that maximum shoaling occurs along the channel edges and minimum shoaling occurs along the channel center line. The infill patterns also show that the shoaling pattern is fairly consistent from year to year.

54. Since condition surveys were conducted during June 1981 and February 1982, it was possible to conduct an analysis of incremental shoaling from the February 1981 postdredging survey to the September 1982 predredging survey. The surveys used in the evaluation were:

a. February 1981 (postdredging)

b. June 1981 (condition)

c. February 1982 (condition)

d. Septemper 1982 (predredging)

55. The depth contours for the February 1981 and June 1981 surveys, along with the corresponding infill pattern, are shown in Figure 22. The depth contours for the June 1981 and February 1982 surveys, along with the corresponding infill pattern, are shown in Figure 23. The depth contours for the February 1982 and September 1982 surveys, along with the corresponding infill pattern, are shown in Figure 24.

56. The width-average depth at each channel range shown for each of the four surveys is shown in Table 7.

57. The comparison of overall average depth for each survey versus elapsed time is shown in Figure 25. The overall average shoaling rate over the range of depths observed (37 to 30 ft) was fairly linear. In other words, the shoaling rate between 37 and 34 ft was about the same as that between 33 and 30 ft.

58. This observation agrees with the results of a field test conducted by USAED, Mobile (1964), during 1964 under the guidance of the CTH. The purpose of that effort was to determine the feasibility of dredging a sump (10 ft overdepth dredged) in a portion of the channel which would attract sediment that would otherwise deposit along the channel, thereby reducing maintenance dredging costs by concentrating deposition over a smaller area. The location of the sump is shown in Figure 26.

59. The result was that shoaling material was not attracted to the sump. That section of the channel shoaled at about the same rate as it did

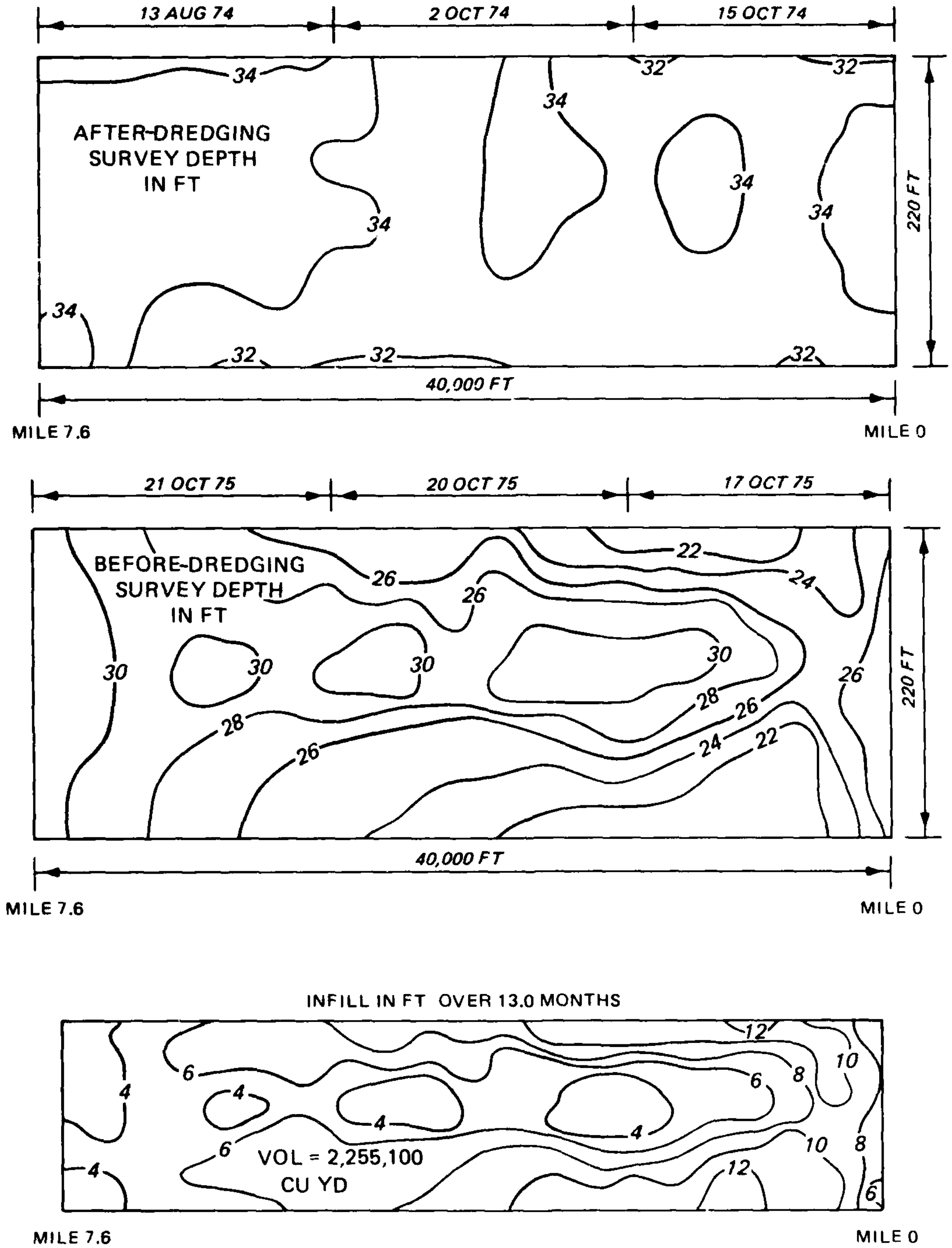


Figure 17. Gulfport Harbor infill patterns, 1974-1975

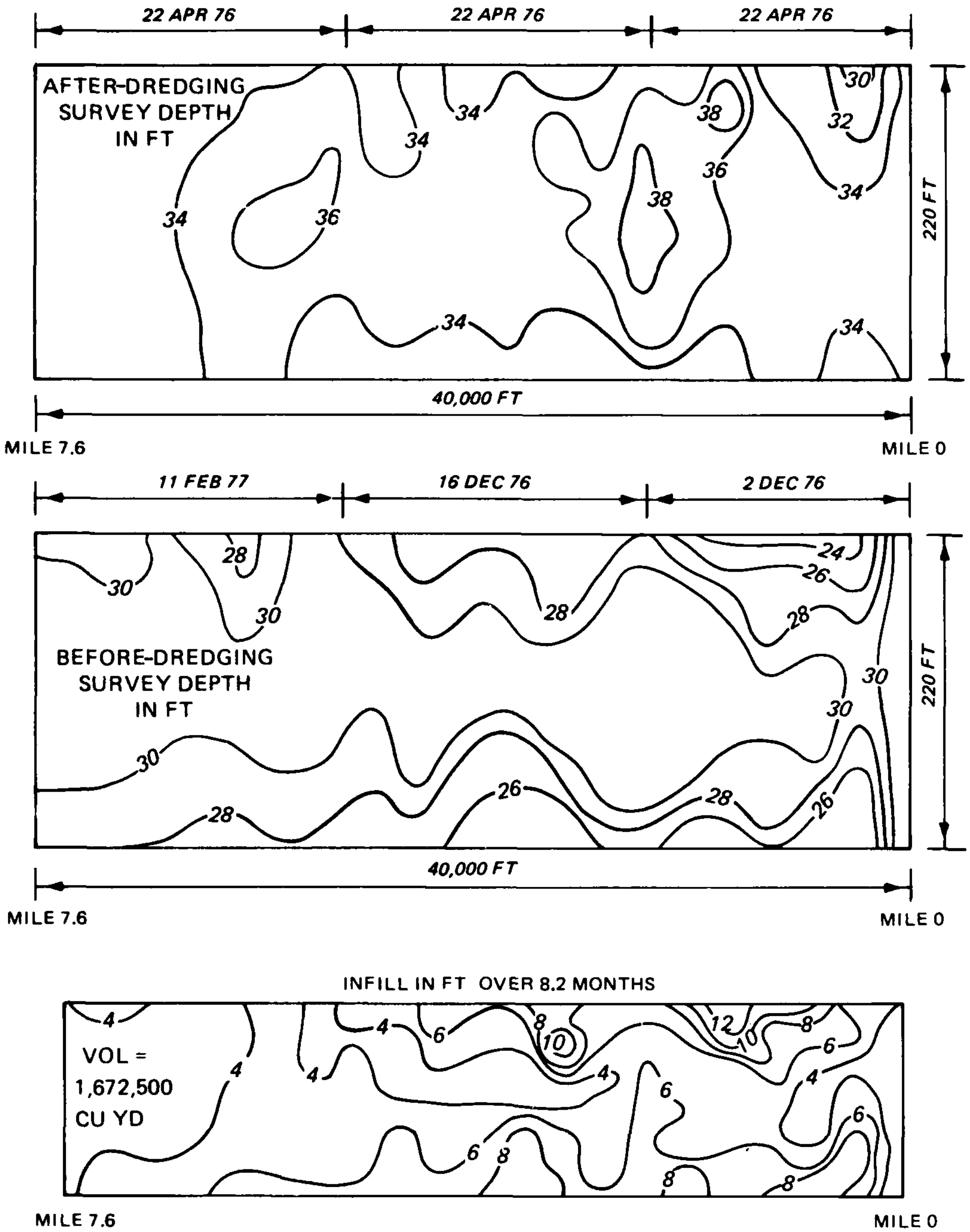


Figure 18. Gulfport Harbor infill patterns, 1976

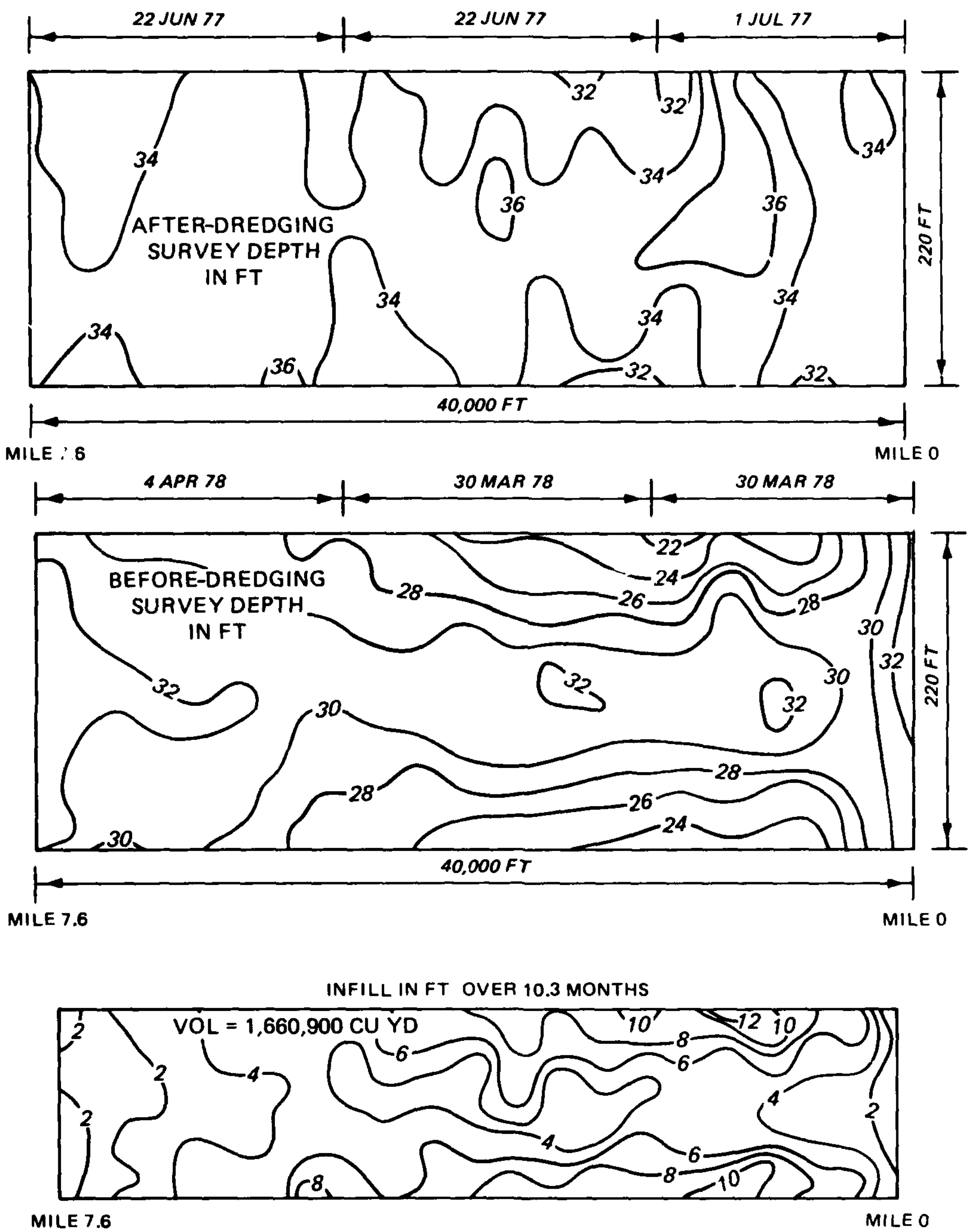


Figure 19. Gulfport Harbor infill patterns, 1977-1978

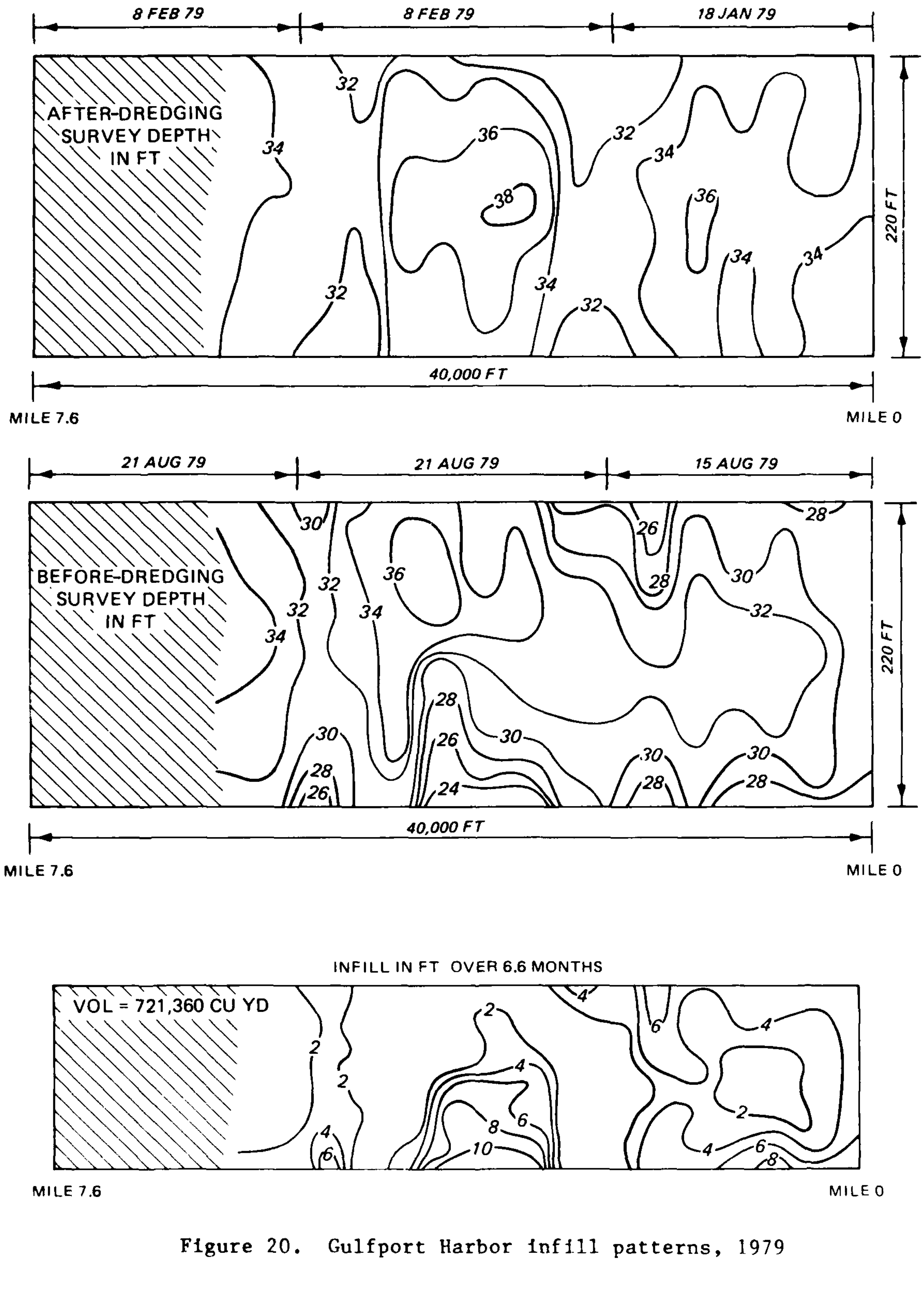


Figure 20. Gulfport Harbor infill patterns, 1979

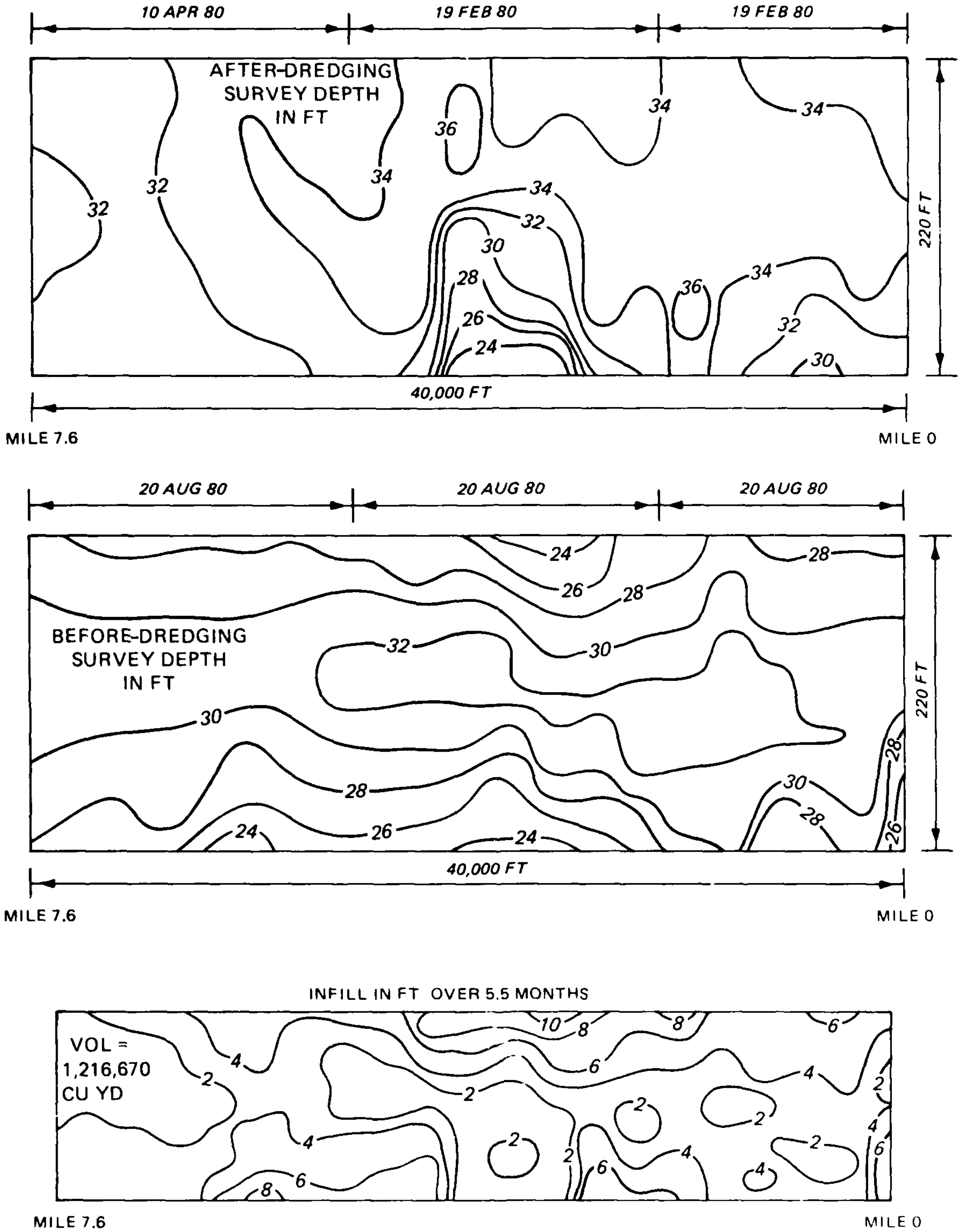


Figure 21. Gulfport Harbor infill patterns, 1980

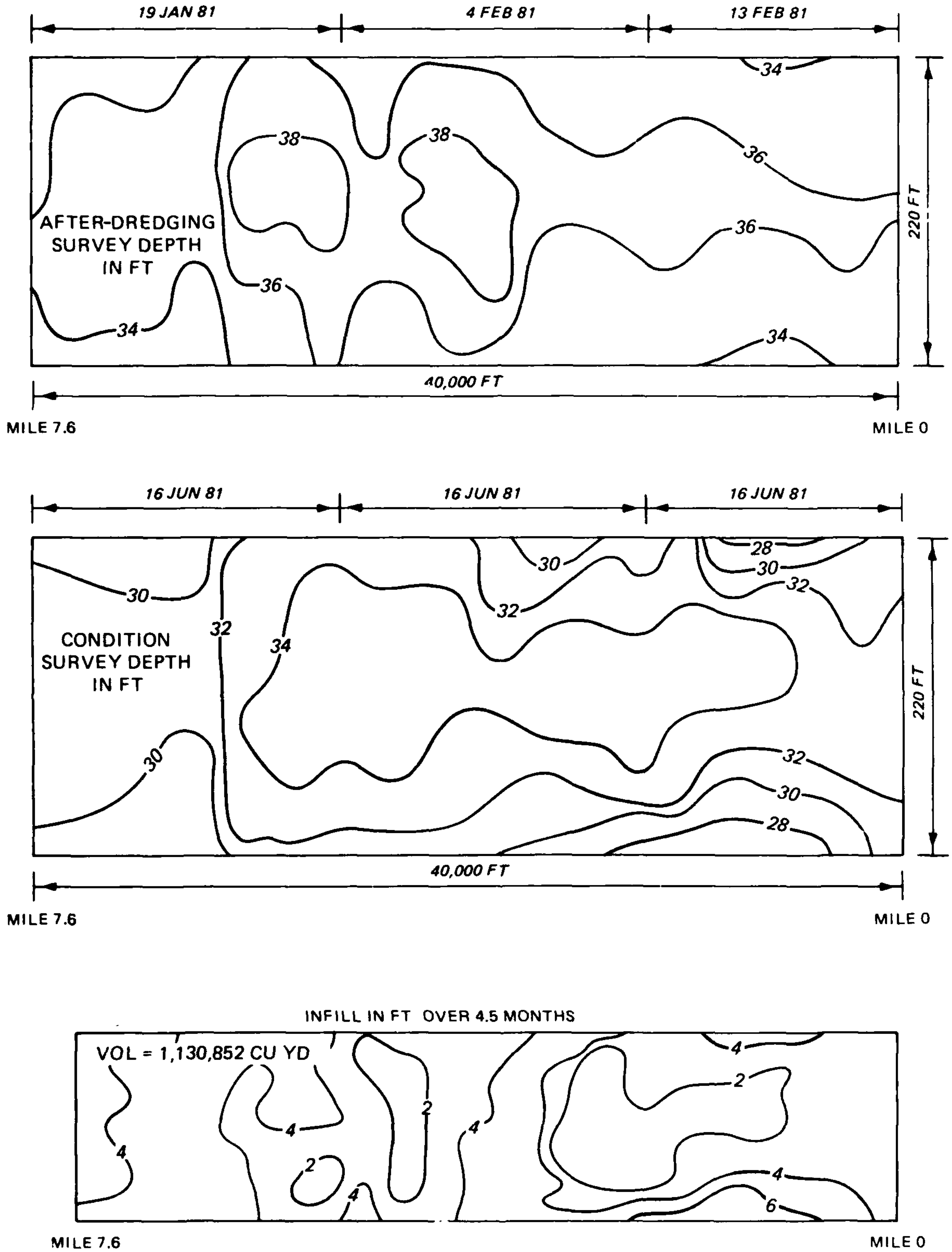


Figure 22. Gulfport Harbor infill patterns, 1981

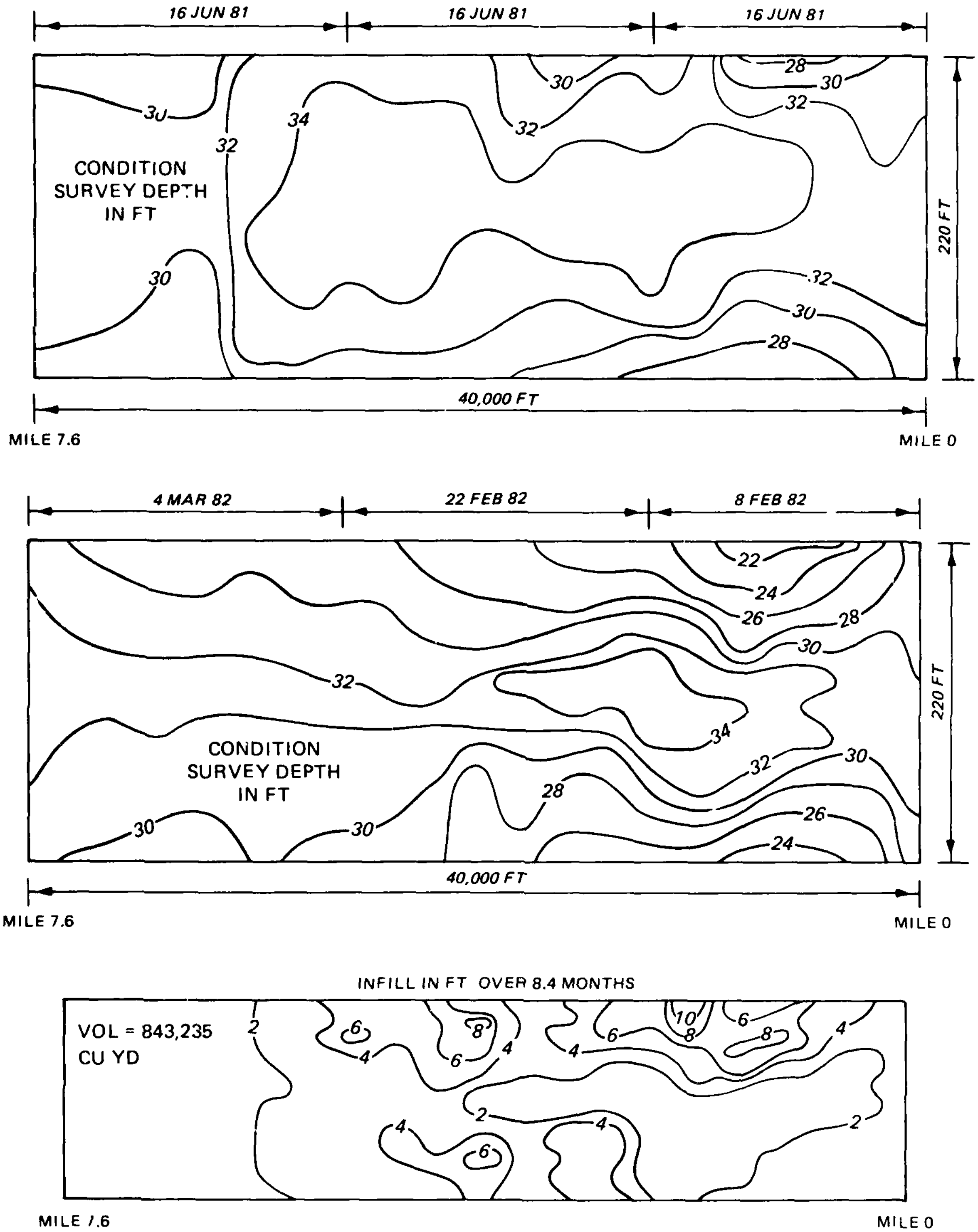
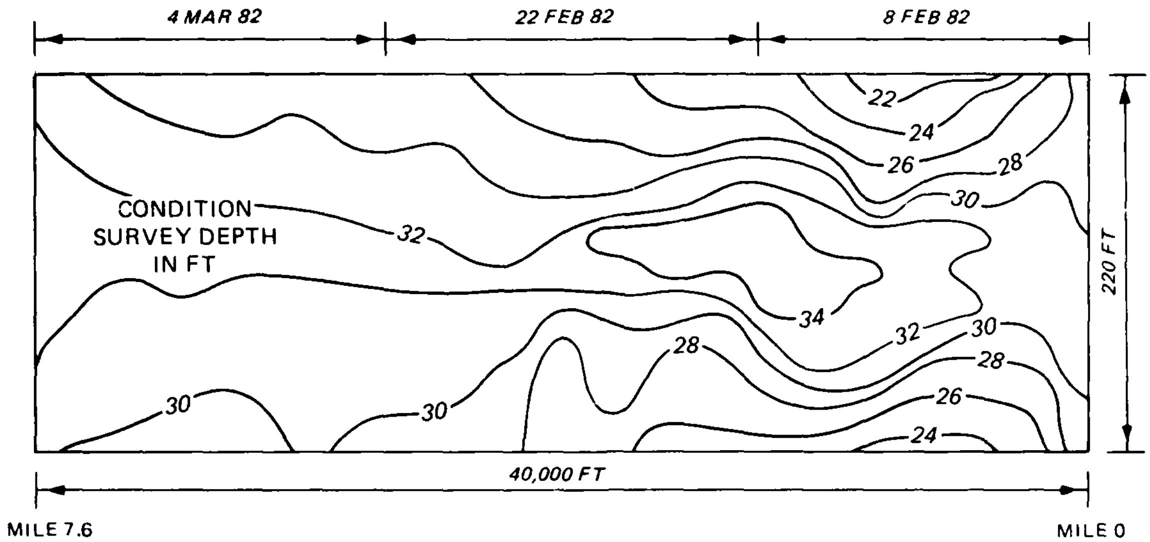
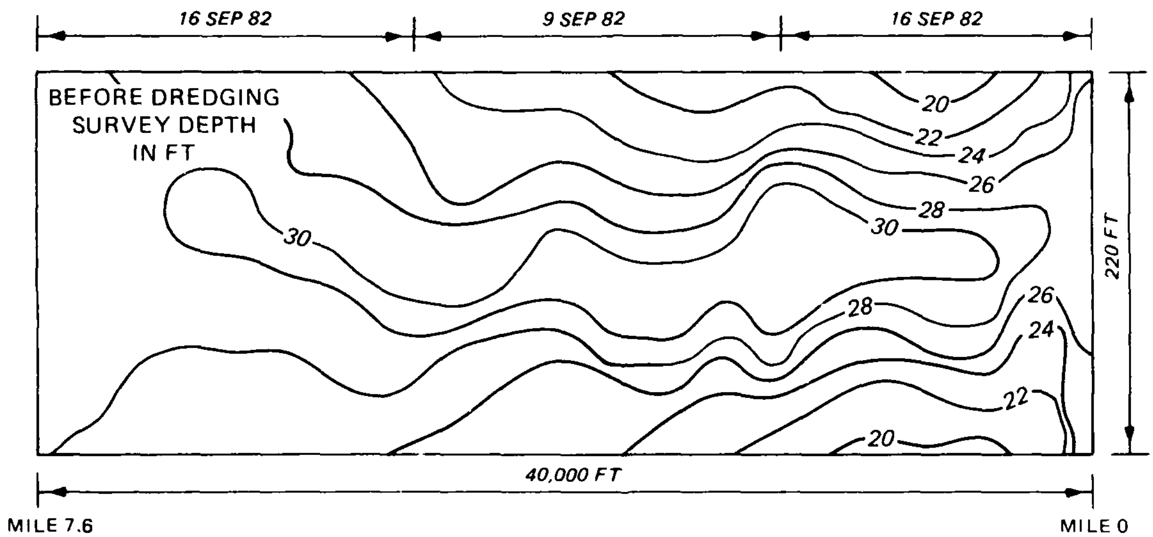


Figure 23. Gulfport Harbor infill patterns, 1981-1982





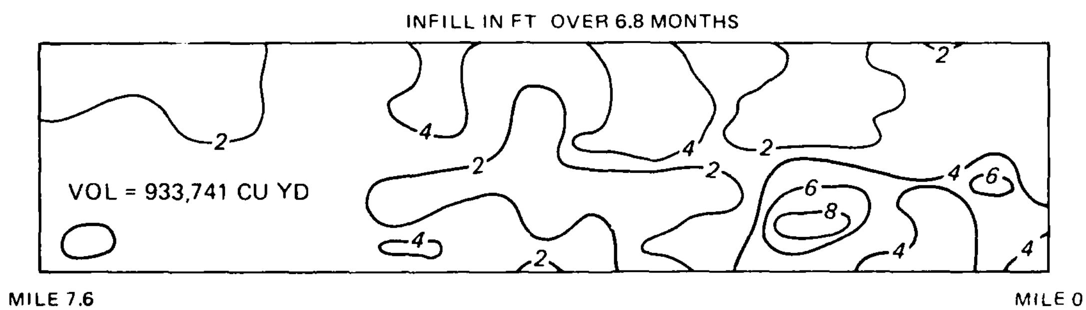


Figure 24. Gulfport Harbor infill patterns, 1982

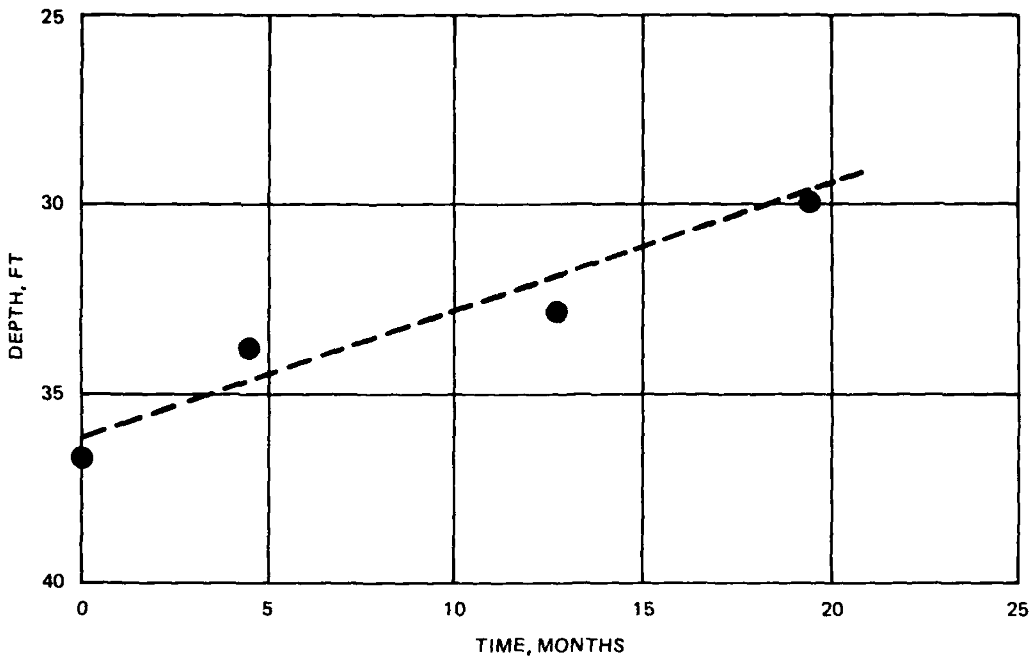


Figure 25. Gulfport Harbor observed shoaling rate as a function of depth during 1981-1982

before it was overdepth dredged, as indicated by the following tabulation (CTH 1964).

	Reach Annual Shoaling Rates, ft		
Condition	sta 4+000 to 8+000	sta 8+000 to 12+000 (Sump)	sta 12+000 to 16+000
Without sump	12	11	11
With sump	11	12	9

60. Although in some cases, increased channel depth has increased shoaling, the insensitivity of shoaling to dredged depth as observed in these two instances indicated that overdepth advance maintenance can be effective in reducing the frequency of required maintenance dredging along this channel. The USAED, Mobile, has recently increased the amount of advance maintenance from 2 to 4 ft, but the shoaling response to these changes has not yet been determined.

Pascagoula Harbor Entrance Channel

Location and description

61. Pascagoula Harbor is located in southeastern Mississippi along the

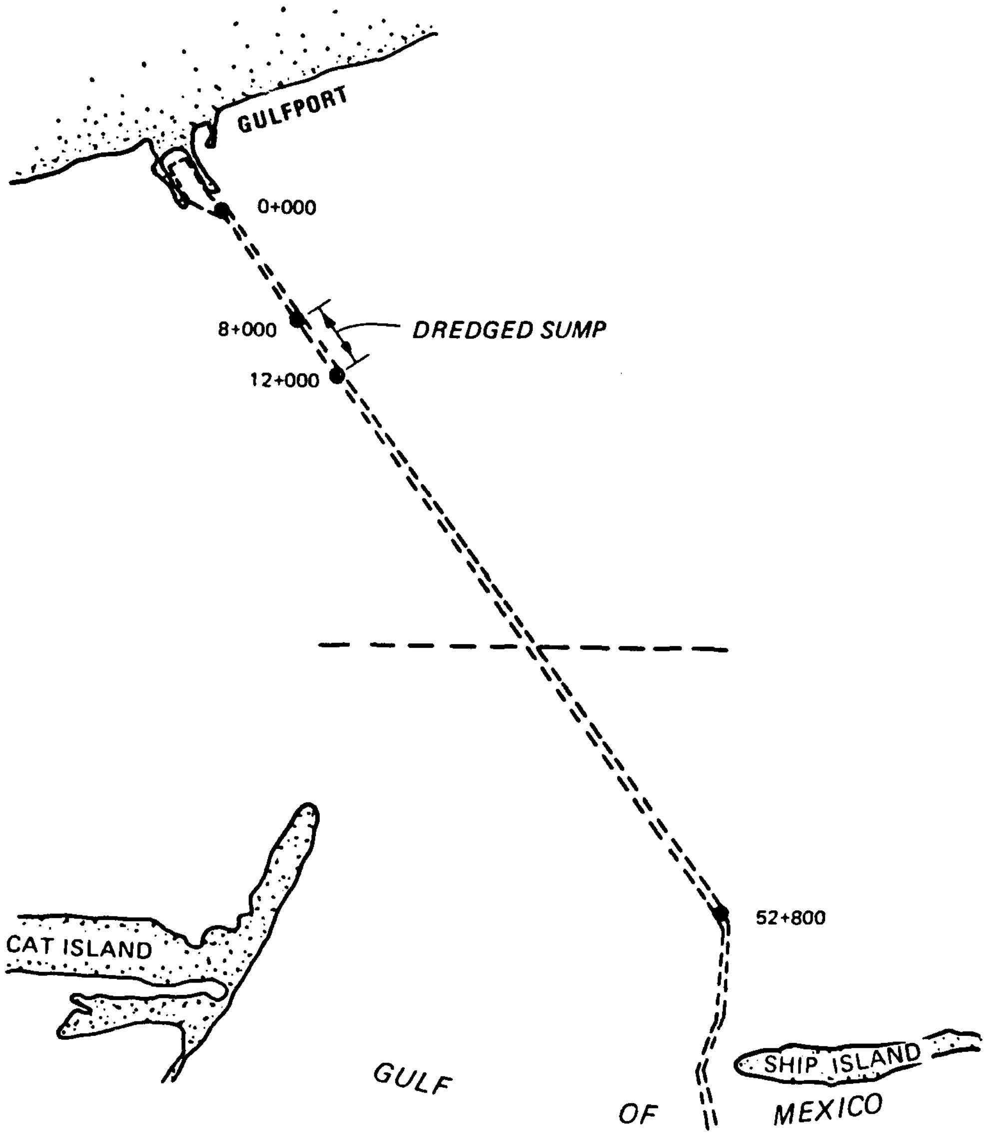


Figure 26. Location of sump dredged in Gulfport Harbor channel in 1964

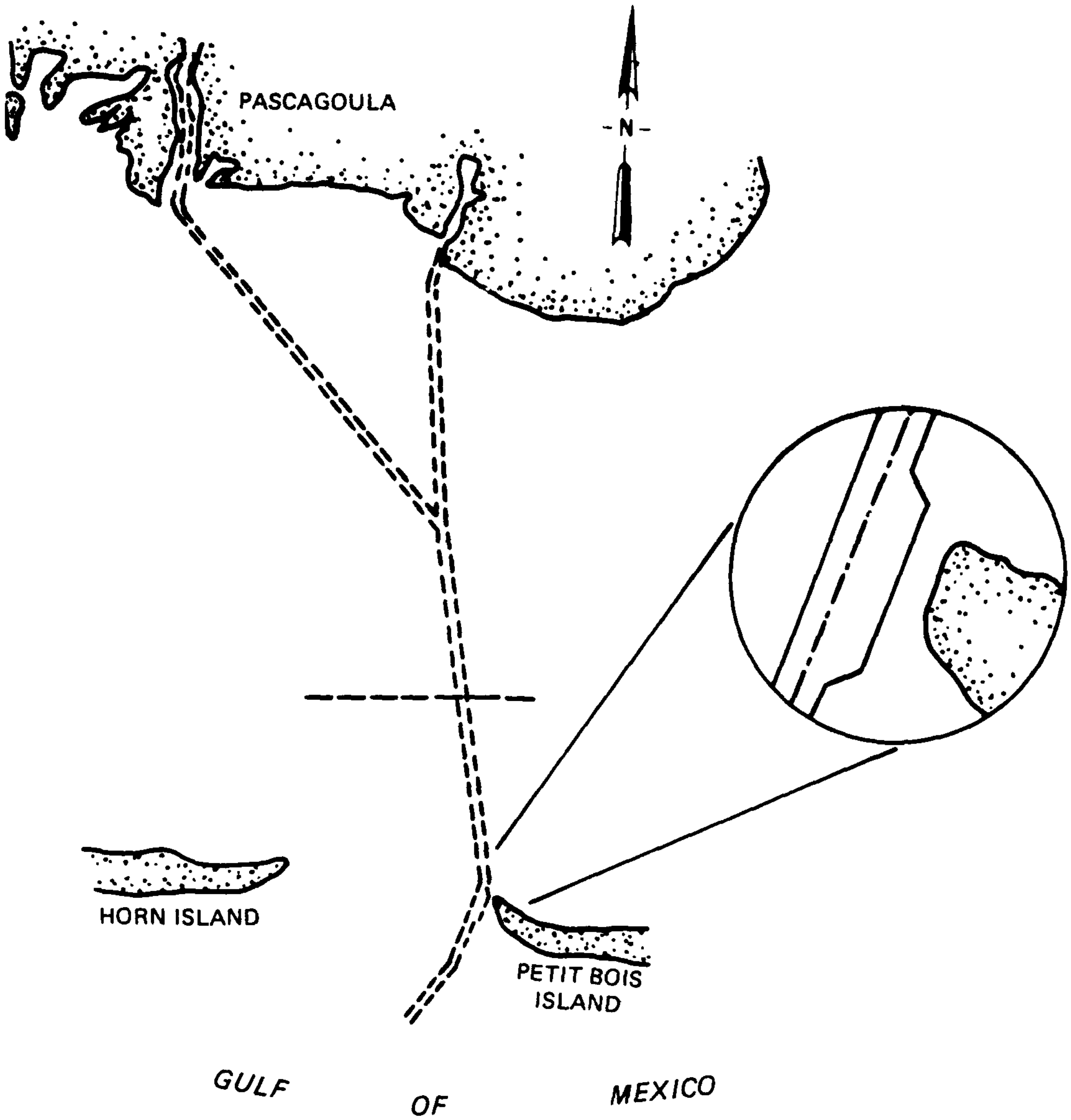


Figure 27. Pascagoula Harbor channel

lower 6.8 miles of Pascagoula River, the lower 6 miles of Dog River, and in Bayou Casotte. It is about 61 miles by water west of Mobile Harbor, Alabama, and about 44 miles by water east of Gulfport Harbor, Mississippi.

62. The existing project (Figure 27) provides, in part, for an entrance channel 40 ft deep and 350 ft wide from the Gulf of Mexico through Horn Island Pass, including an impounding area for littoral drift, 40 ft deep, 200 ft wide, and about 1,500 ft long, adjacent to the channel at the west end of Petit Bois Island and a navigation channel 38 ft deep and 350 ft wide through Mississippi Sound to a turning basin, 38 by 950 by 2,000 ft at Pascagoula (OCE 1978).

History of improvements at the entrance

63. The existing Pascagoula Harbor entrance and navigation channel developed through the following River and Harbor Acts (OCE 1978):

a. 4 March 1913. Provided for a channel 25 ft deep and 300 ft wide through Horn Island Pass (construction completed in 1940) and another channel 22 ft deep by 225 ft wide across Mississippi Sound (construction completed in 1942).

b. 3 September 1954. Provided for enlarging the channel through the pass to 35 by 325 ft (construction completed in 1960) and the sound channel to 30 by 275 ft (construction completed in 1960).

c. 14 July 1960. Provided for deepening the channel to 38 ft in Horn Island Pass (construction completed in 1962) and to 33 ft in Mississippi Sound (construction competed in 1962).

d. 23 October 1962. Provided for the existing dimensions. The existing project was completed in 1965.

Hydraulic characteristics

64. At Pascagoula the tides are strongly influenced by the force and direction of the wind. Under ordinary conditions, the mean tidal range is 1.75 ft and the extreme range is 3.75 ft (CTH 1971).

65. Maximum velocities of currents under ordinary conditions are 3.4 ft/sec at the outer bar to the entrance of Horn Island Pass, 2.6 ft/sec in Mississippi Sound, and 2.4 ft/sec in the Pascagoula River channel (CTH 1971).

Shoaling characteristics

66. Most of the shoaling in the Mississippi Sound channel occurs between its intersection with the Bayou Casotte Channel northward to the turning basin at Pascougoula. Based on OCE Annual Reports from 1970-1974, maintenance dredging in the Mississippi Sound portion of the project averages about 1.4 million cu yd annually.

67. The shoaling in the entrance channel at Horn Island Pass, which results from littoral transport off Petit Bois Island, averages about 0.5 million cu yd annually, according to the OCE Annual Reports.

Results of project evaluation

68. An evaluation of the effectiveness of the impounding area, which is actually overwidth advance maintenance, was conducted.

69. The hydrographic surveying program applied to the entrance area did not allow the detailed evaluation of yearly shoaling from the construction of the impounding area in 1965 to the present because the impounding area was not surveyed each time the main channel was surveyed. An evaluation of the

channel shoaling which occurred after maintenance dredging in March 1978 was possible.

70. During the March 1978 maintenance dredging, the impounding area was not dredged, so that the subsequent shoaling was representative of a channel in which overwidth advance maintenance was not performed. The channel condition at 1 month and 5-1/2 months after dredging are shown in Figures 28 and 29, respectively. After 5-1/2 months the channel blockage was severe, with the east edge shoaled to 0 depth.

71. An evaluation of the entrance channel shoaling which occurred after dredging in July 1980 was performed. In this case the impounding area was dredged, so that the subsequent shoaling was representative of a channel in which overwidth advance maintenance was performed. The channel condition about 4-1/2 months after dredging is shown in Figure 30. In this instance the entrance channel blockage is slight, with only minor loss of project depth on the east edge of the entrance channel.

72. The data are limited and sediment supply conditions for the 2 years that are compared may differ, but the results suggest that the 1980 channel

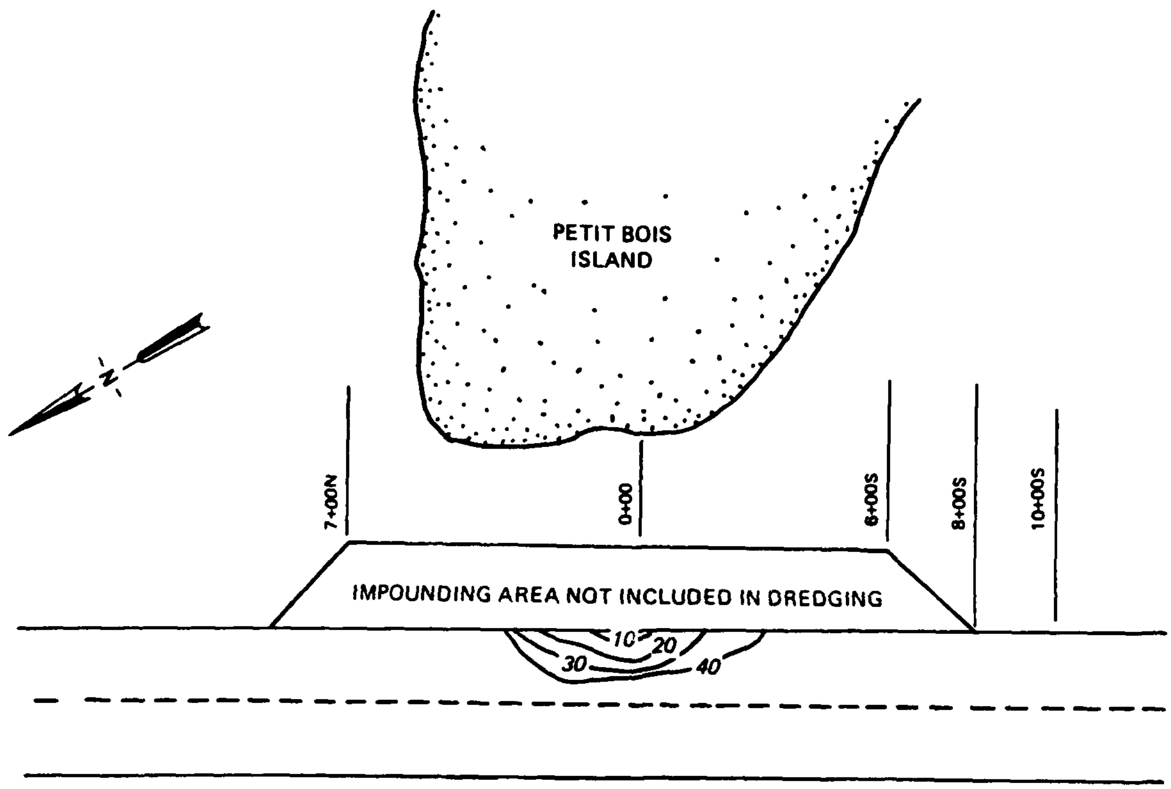


Figure 28. Pascagoula Harbor entrance channel condition on 30 March 1978, 1 month after dredging (impounding area not dredged)

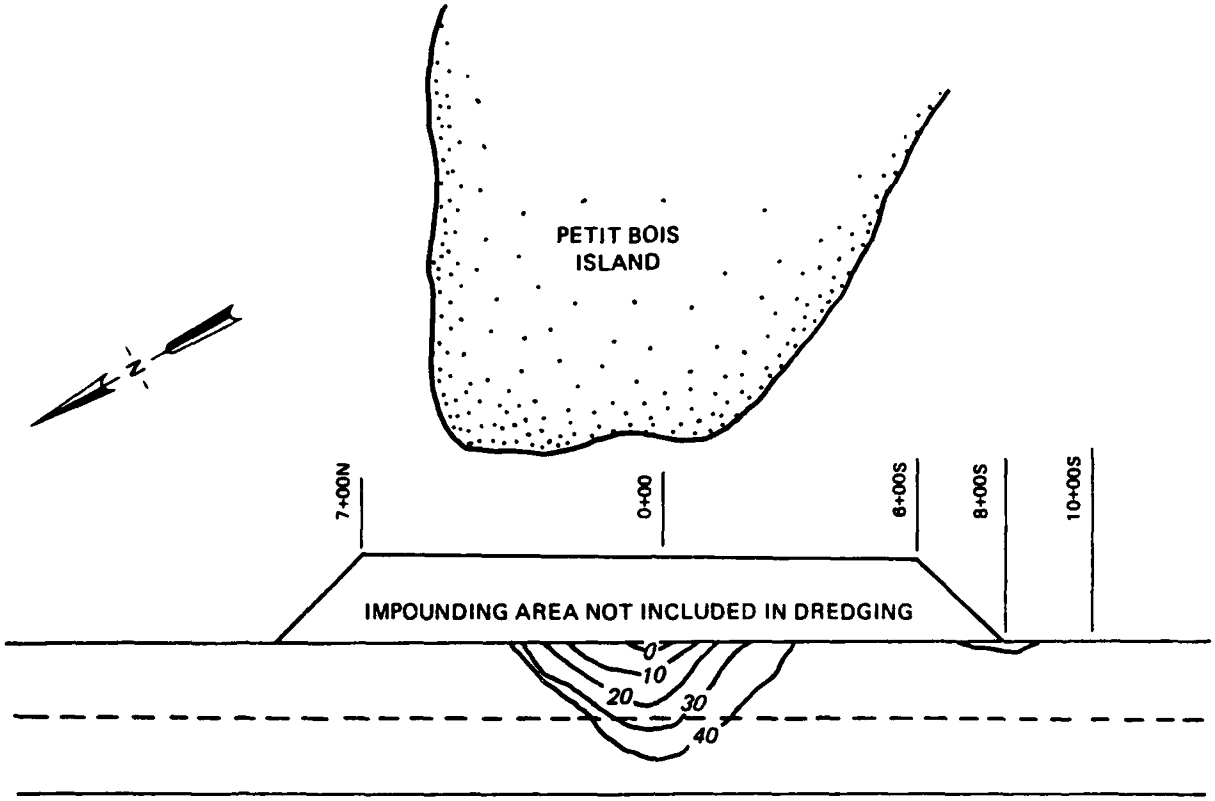


Figure 29. Pascagoula Harbor entrance channel conditon on 22 August 1978, 5-1/2 months after dredging (impounding area not dredged)

with overwidth dredging (impounding area) provided project dimensions for a greater period of time than the 1978 channel without overwidth dredging.

Galveston Harbor Entrance Channel

Location and description

73. The Galveston Harbor entrance channel is located on the coast of Texas, about 70 miles southwest of the Texas-Louisiana boundary.

74. The existing project at the entrance consists of two rubble-mound jetties and a channel 42 ft deep at mean low tide and 800 ft wide from deep water in the Gulf of Mexico across an outer bar to a point about 2 miles west of the seaward end of the north jetty; then, 40 ft deep and 800 ft wide to Bolivar Roads. This portion of the channel, about 3.2 miles long, is referred to as the Inner Bar Channel. The south jetty at Galveston Island is 35,900 ft long while the north jetty at Bolivar Peninsula is 25,907 ft long.

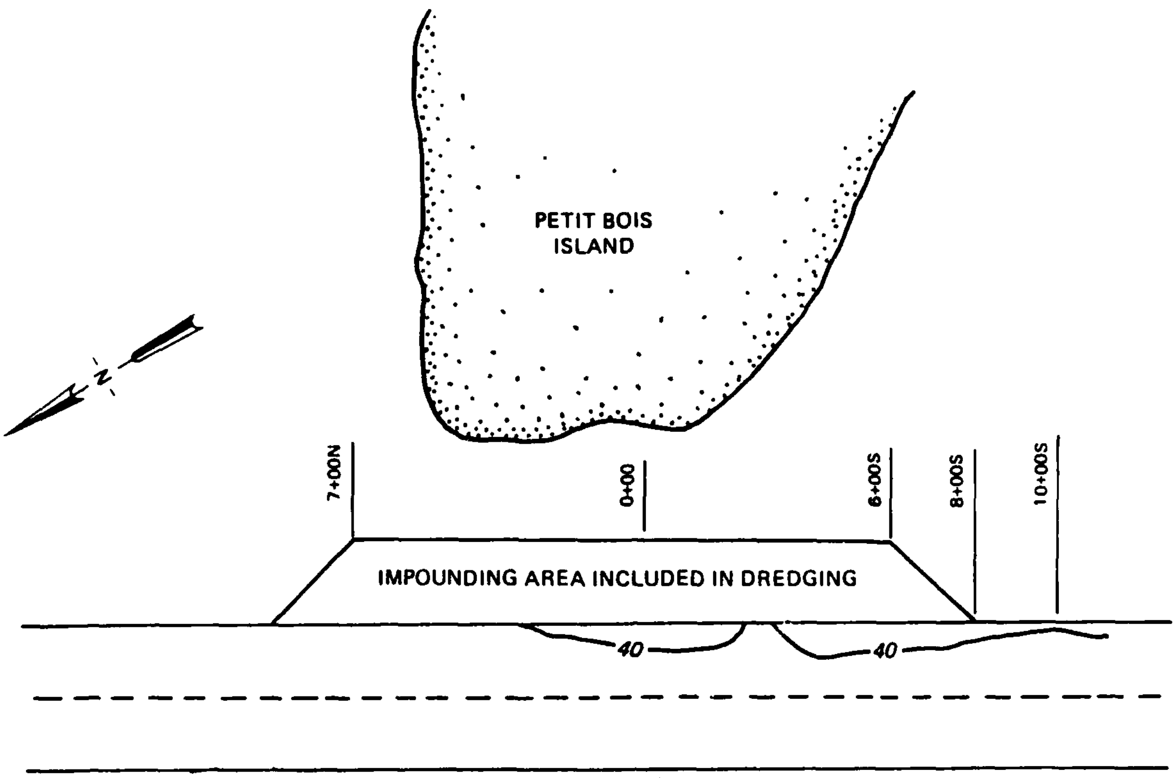


Figure 30. Pascagoula Harbor entrance channel condition on 9 December 1980, 4-1/2 months after dredging (impounding area dredged)

History of improvements at the entrance

75. The jetties which were completed in 1910 were authorized by the River and Harbor Act of 5 August 1886. The River and Harbor Act of 2 March 1907 authorized extension of the jetties to their present lengths (OCE 1955).

76. A 35- by 800-ft channel was completed in 1922. The outer bar segment of the channel was deepened to 36 ft with the inner bar at 34 ft in 1938. The outer and inner bars were deepened to 38 and 36 ft, respectively, in 1950. Deepening of the channels to their presently authorized depths and realignment of the inner bar channel were completed in 1968 (OCE 1977).

Hydraulic characteristics

77. Tides at Galveston Bay are predominantly diurnal. Mean tidal range on the outer bar is 1.6 ft, with an extreme range of 2.3 ft. On the inner bar the mean range of tide is 1.4 ft and the extreme range is 2.1 ft (CTH 1971).

78. Maximum flood currents in the entrance channel are about 2.9 ft/sec while maximum ebb currents are about 3.9 ft/sec (Jarrett 1976).

Shoaling characteristics

79. Sand is predominant in the jettied entrance channel although there is considerable amount of silty material of the Trinity River type forming the inner bar (CTH 1971).

Results of project evaluation

80. Data extracted from predredge and postdredge survey sheets were used to determine shoaling volumes and infill rates for six shoaling periods between September 1958 and May 1964 for the outer bar portion of the Galveston entrance channel. The channel alignment during this period is shown in Figure 31. (In 1965 the entrance channel was realigned to reduce shoaling.) During this period, authorized project dimensions, specified by Congressional action, were a 38-ft depth and an 800-ft width. According to information acquired from USAED, Galveston, the required depth (minimum dredging depth needed prior to acceptance of work for pay purposes) for the dredging operations preceding the first three shoaling periods was 38 ft plus 2 ft of dredging tolerance. For the other three dredging operations, required depth was 40 ft, including 2 ft of advance maintenance, plus 2 ft of dredging tolerance.

81. To determine more accurately the distribution of shoaling throughout the entire channel, the channel was divided into six 3,000-ft segments between sta 7+000 and 25+000 (Figure 32).

82. Table 8 lists annual shoaling volumes at each segment for each of the six shoaling periods.

83. Shoaling distribution was relatively even throughout the channel for both depths. The segment from sta 7+000 to 13+000 averaged 408,000 cu yd in annual shoaling volume for the 38-ft dredged depth. This represented 38 percent of the total volume. For the 40-ft dredged depth, average annual shoaling amounted to 366,000 cu yd, about 35 percent of the total volume. This represented a decrease of approximately 12 percent in shoaling quantity when compared to the 38-ft dredged depth.

84. The middle segment, sta 13+000 to 19+000, also experienced a slight reduction (about 3 percent) in average annual shoaling volume for the deeper channel. For the 38-ft depth, shoaling averaged 353,000 cu yd annually, or about 33 percent of the total, while for the 40-ft depth the annual average was 342,000 cu yd or 32 percent of the total.

85. The outer portion of the channel, sta 19+000 to 25+000, showed an increase of approximately 14 percent in shoaling volume for the deeper

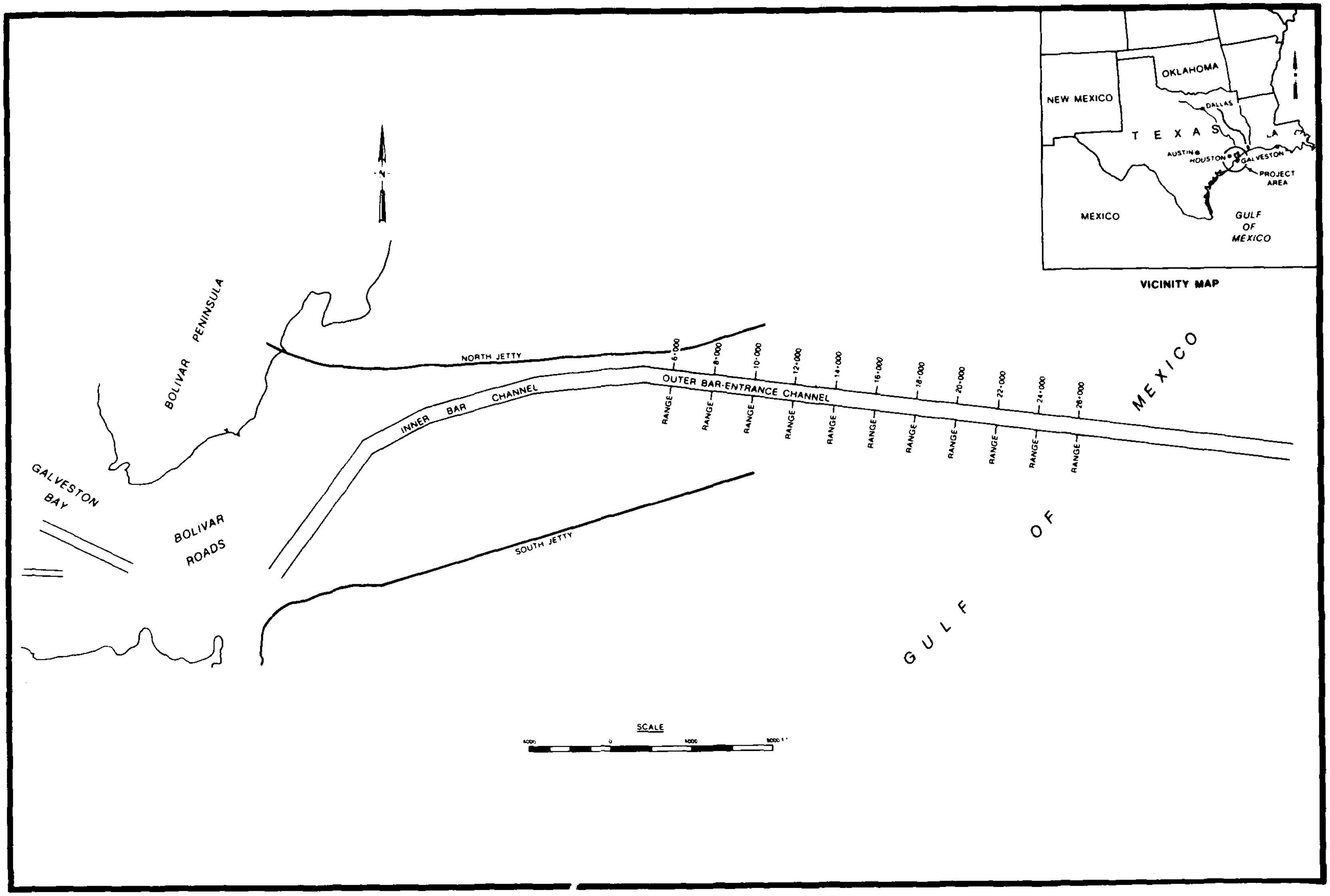


Figure 31. Galveston Harbor entrance channel alignment during the period 1958-1964

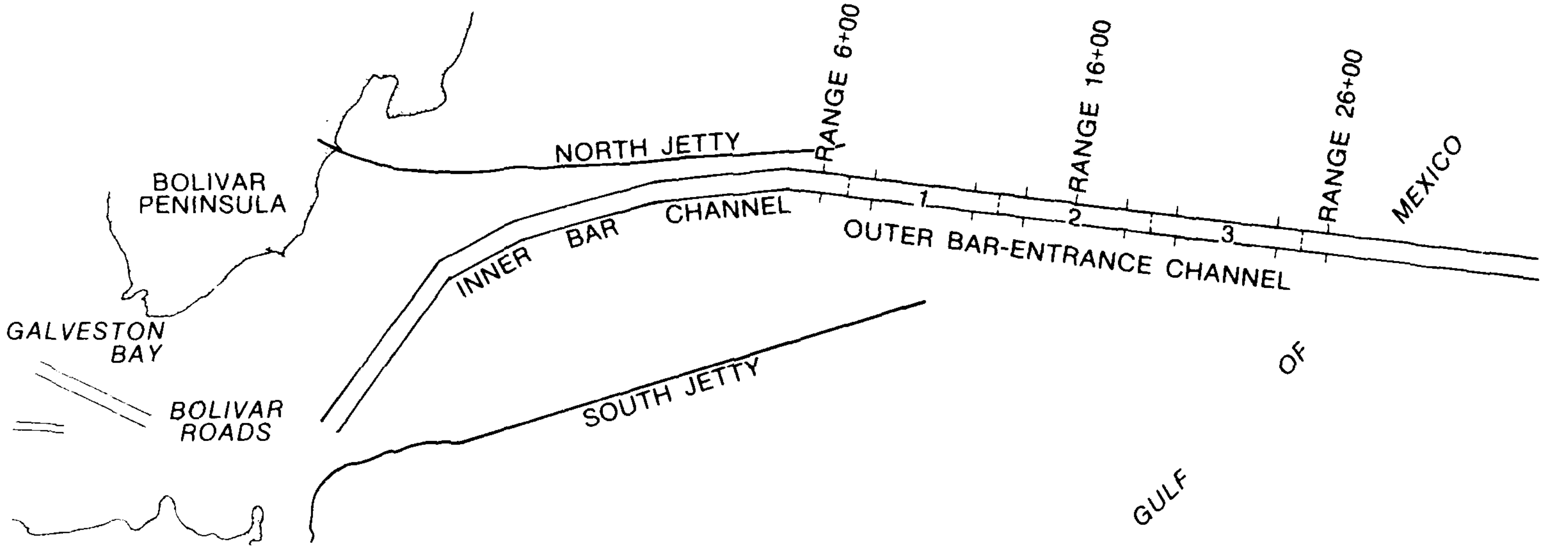


Figure 32. Galveston Harbor entrance channel segments for shoaling analysis

dredgings. The average annual volume of 348,000 cu yd represented approximately 33 percent of the total volume. For the 38-ft required depth, the average annual volume was 304,000 cu yd, about 29 percent of the total volume.

86. There was no significant difference in overall average annual shoaling volume between the two required dredged depths. For the 38-ft required depth, the annual volume was 1,065,000 cu yd, while for the 40-ft required depth, including 2 ft of advance maintenance, the shoaling volume was 1,056,000 cu yd, a difference of 1 percent. Although the data base is limited, the results suggest that the Galveston outer bar channel has potential for the effective use of advance maintenance.

PART IV: EVALUATION OF PACIFIC COAST PROJECTS

Coos Bay Entrance Channel

Location and description

87. Coos Bay is located on the Pacific coast of Oregon 200 miles south of the mouth of the Columbia River and 445 miles north of San Francisco Bay. It is about 13 miles long and 1 mile wide, with an area at high tide of about 15 square miles (Figure 33).

88. As shown in Figure 34, the existing project at the entrance consists of two rubble-mound, high-tide jetties and a flared navigation channel across the outer bar. The channel is 45 ft deep* and 700 ft wide at the seaward end, reducing gradually to a depth of 35 ft and a width of 300 ft at Guano Rock near river mile 1 (OCE 1983).

History of improvements at the entrance

89. The south jetty was completed in 1928. It was restored in 1941-1942 by construction of a concrete cap for the full length of the jetty and was rehabilitated in 1962-1963. The north jetty was completed in 1929 and repairs to it were completed in 1970 (OCE 1983).

90. In 1937 the entrance channel was constructed to a depth of 24 ft and a width of 300 ft. Enlargement of the channel dimensions to 40 by 700 ft, with the dimensions gradually reduced to 30 by 300 ft at Guano Rock was completed in 1952. The existing dimensions were completed in 1979 (OCE 1983).

Hydraulic characteristics

91. Mean tidal range at the entrance is 5.2 ft with a corresponding tidal prism of 1.9 billion cu ft. Diurnal range is 7.0 ft with a tidal prism of 2.5 billion cu ft. Extreme range of tide at the entrance is 11.0 ft (Johnson 1972).

92. Maximum flood currents in the entrance channel are about 3.0 ft/sec. Maximum ebb currents are about 3.7 ft/sec (Jarrett 1976).

93. There are nearly 30 tributaries feeding the Coos Bay system. Coos River, which discharges into the bay about 12 miles from the mouth of the estuary, is the largest tributary with a freshwater annual yield of

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* All depths in this part are referred to mean lower low water (mllw).

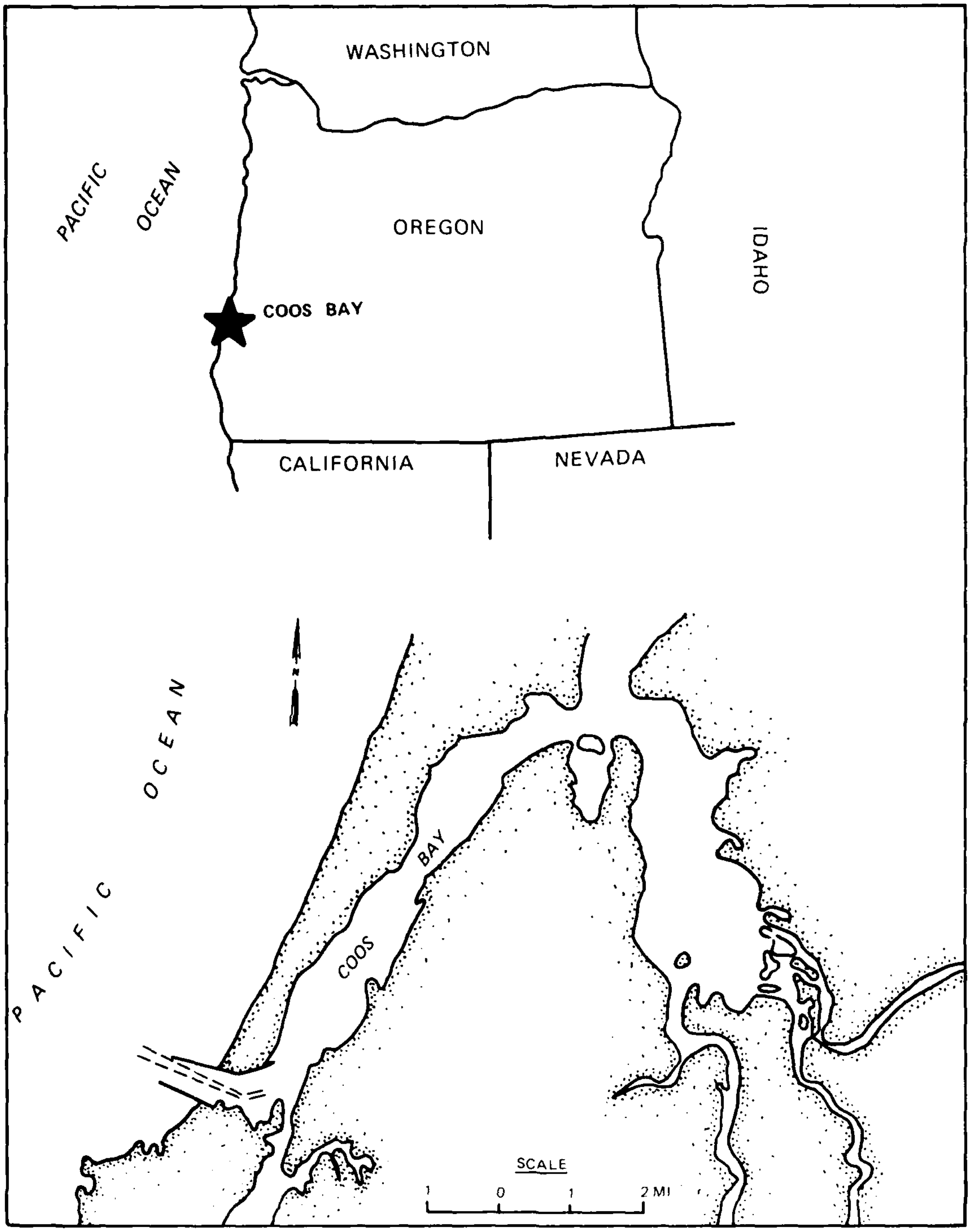


Figure 33. Coos Bay, Oregon

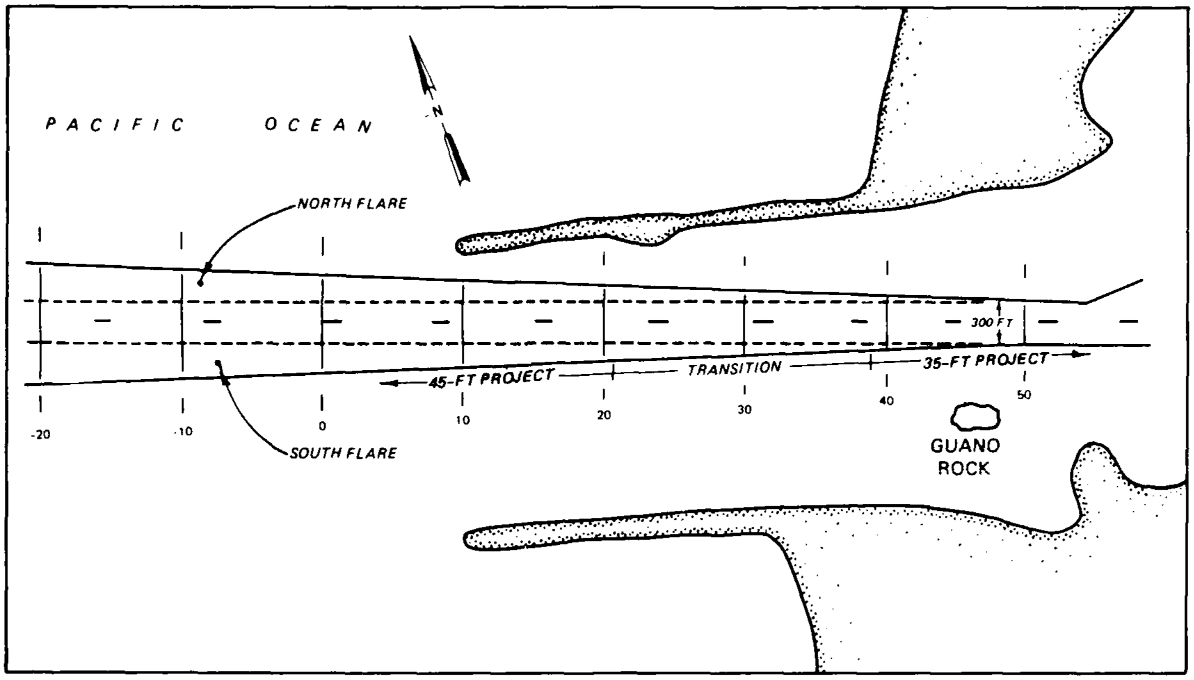


Figure 34. Coos Bay entrance channel

1.6 million acre-ft. The bay has a drainage area of approximately 605 square miles from which an average of 72,000 tons of sediment is transported annually to the estuary (Percy et al. 1974).

94. Based on measurements of temperature, salinity, and currents conducted between 1960 and 1963, Coos Bay has been described as a well-mixed estuary during periods of low freshwater flow and as a partially mixed estuary during the time of maximum freshwater flow (McAllister and Blanton 1963).

Shoaling characteristics

95. The typical shoaling pattern of the entrance channel is shown in Figure 35. There are two major shoals in the area, which are called the entrance shoal and the transition shoal (USAED, Portland, 1978). Shoal material is mostly sand (SP) (Unified Soil Classification System (USCS)) of coastal origin (USAED, Portland, 1978). Littoral transport at Coos Bay is to the south in summer and to the north in winter with a net transport to the south (Percy et al. 1974).

Results of project evaluation

96. Coos Bay entrance channel's shoaling volumes and average infill rates were analyzed to determine what effects, if any, the depth increase from 40 to 45 ft and the flared entrance channel had on shoaling quantities and

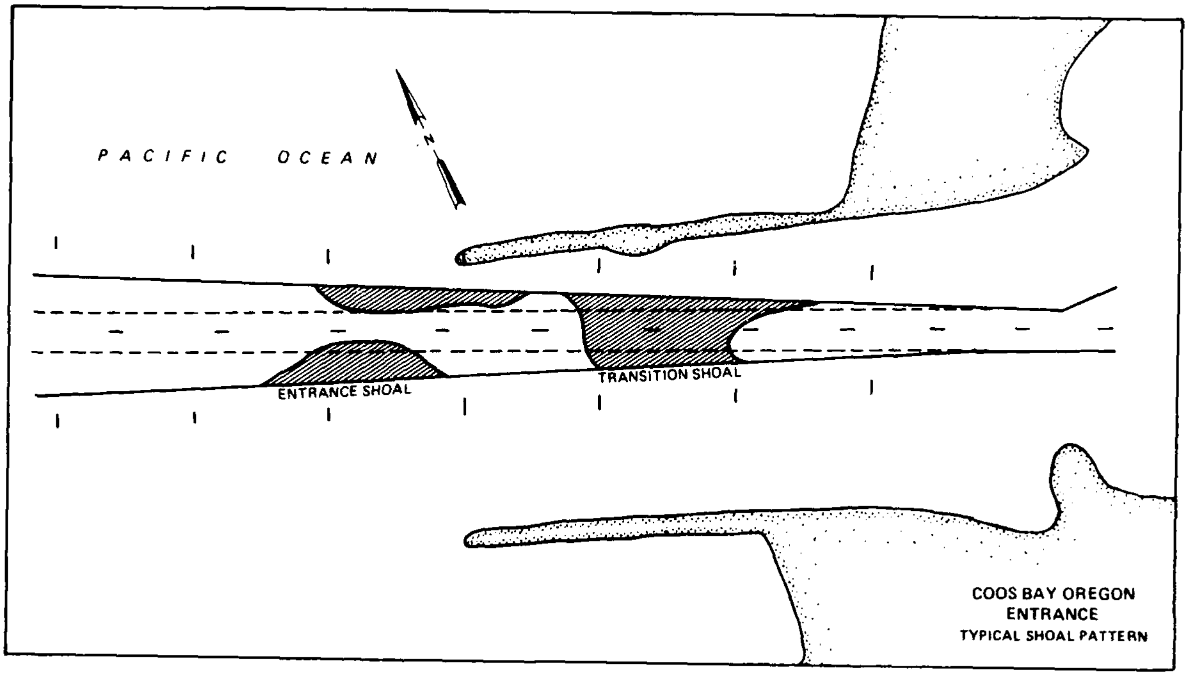


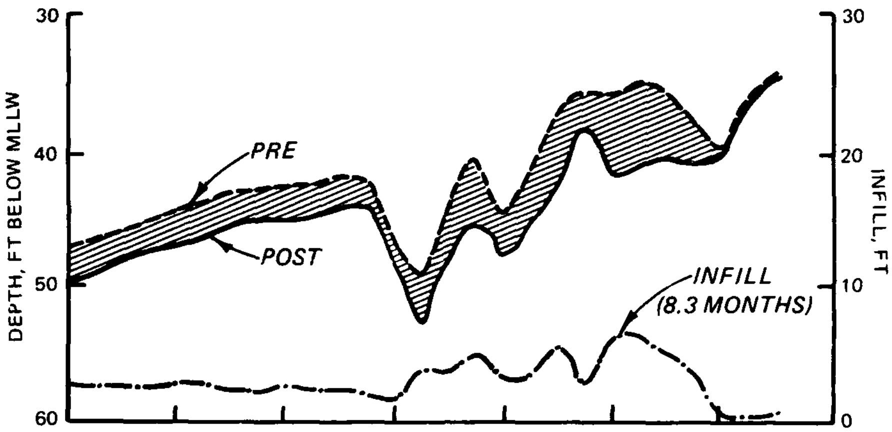
Figure 35. Typical Coos Bay entrance shoaling pattern

patterns. For this evaluation, the flared entrance is considered to be an overwidth form of advance maintenance.

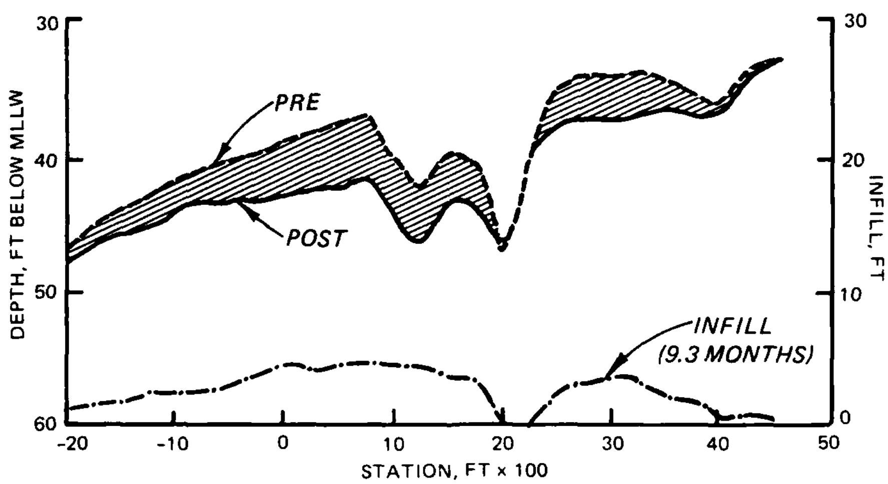
97. Project depth. Predredge and postdredge depths at the entrance for each of five shoaling periods of the 40-ft project are listed in Tables 9-12. The average depth of 29 ranges between sta -20+00 and 50+00 are provided. The range interval is 250 ft. These tables also contain the mean predredge and postdredge depths and the average infill in feet of the overall period (1969-1976) at each range. The north and south halves of the channel, as well as the north and south flares, were examined separately.

98. The same information for three shoaling periods of the 45-ft project during the period from 1976-1979 is listed in Tables 13-16. All the information on these tables were developed using data extracted from hydrographic surveys acquired from USAED, Portland, 1978.

99. The average infill period for the 40-ft project was 9.3 months, while that of the 45-ft project was 8.3 months. Representative infill profiles for both depths are shown in Figure 36. These profiles were developed from the mean depths listed in Tables 9-16. The infill rate of the 40- and 45-ft projects along the north flare is compared in Figure 36. The comparison for the north half of the channel is shown in Figure 37, for the south half of

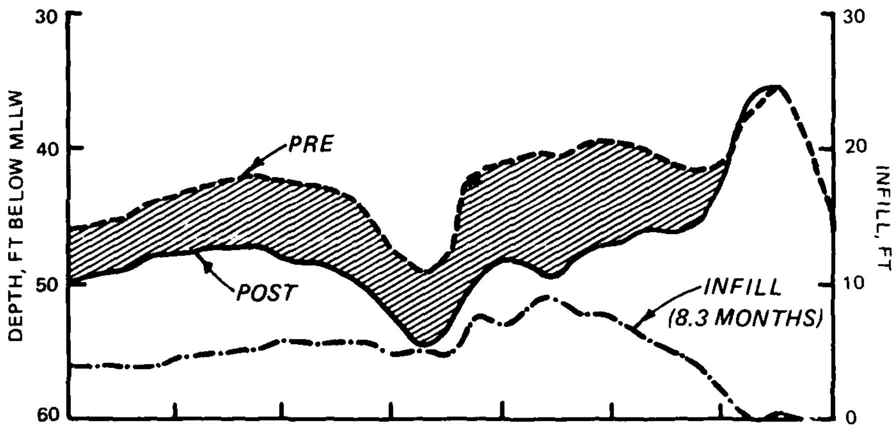


a. 45-ft project

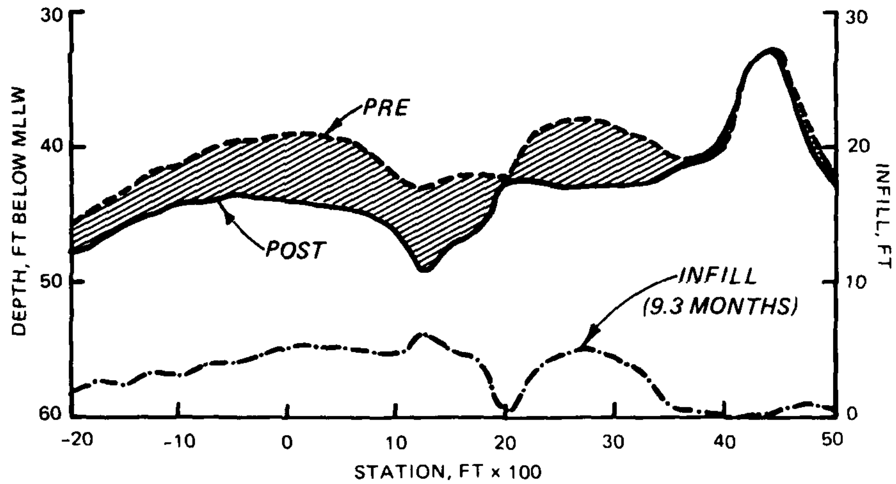


b. 40-ft project

Figure 36. Observed depths and infill rates along the north flare of the Coos Bay entrance channel



a. 45-ft project



b. 40-ft project

Figure 37. Observed depths and infill rates along the north half of the Coos Bay entrance channel

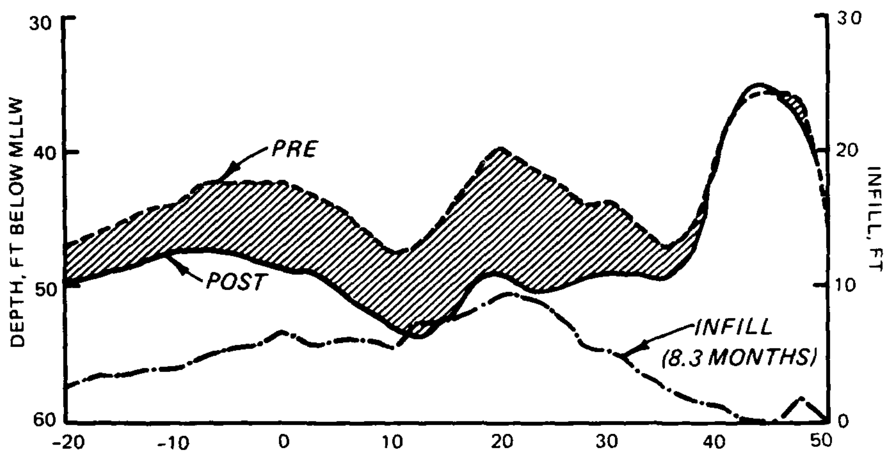
the channel in Figure 38, and for the south flare in Figure 39.

100. The infill curves in Figures 36-39 were integrated to determine corresponding volumes of material. This was done to quantitatively establish the impact of the depth increase on annual maintenance requirements. Results of the integration of these curves were as follows:

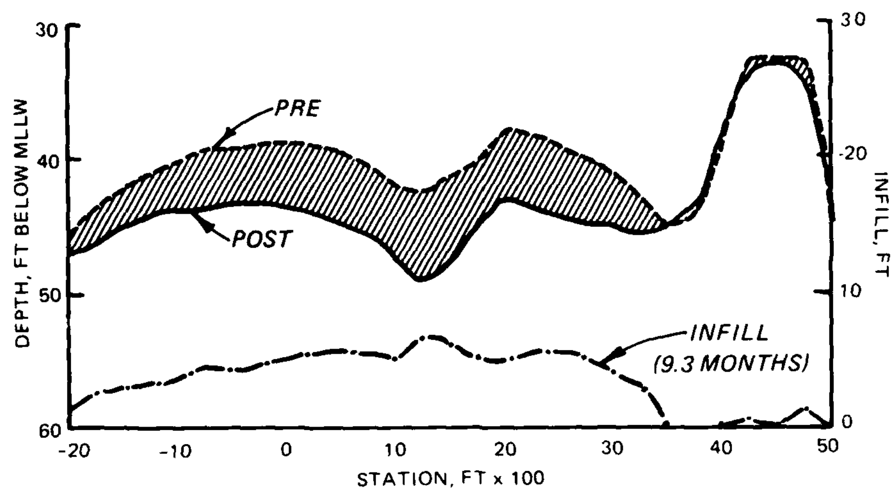
	Average Annual Shoaling Volume, cu yd		
Area	40-ft Project	45-ft Project	Percent Increase
North flare	120,800	134,700	12
North channel	158,900	271,500	71
South channel	181,100	261,700	45
South flare	216,200	278,800	29
Total	677,000	946,700	40

101. The overall increase of 40 percent for the 5-ft channel deepening can be used to estimate increased shoaling from advance maintenance. If the assumption is made that the shoaling-depth relation is linear over the range of 45-50 ft then advance maintenance of 5 ft (to 50 ft) would result in an increase of about 20 percent in overall shoaling. In other words, if the shoaling rate at 45-ft depth is termed the base shoaling rate, then the shoaling rate would vary in a linear fashion from 1.40 × base at 50-ft depth to base at 45-ft depth, resulting in an overall average increase of 1.20 × base, which represents a 20 percent increase in shoaling for the project. The 20 percent increase might be acceptable to achieve advance maintenance benefits. However, the increased dredging volumes associated with the advance maintenance might limit its application in this case.

102. Flared entrance. For the 40-ft project, the north and south flares as defined in Figure 34 accounted for 18 and 32 percent of the total shoaling, respectively. For the 45-ft project, the north and south flares accounted for 14 and 29 percent of the total shoaling, respectively. Thus, the flared portions of the entrance serve effectively as overwidth advance maintenance in that they prevent a more rapid accumulation of shoal material in the channel proper. As an example, the predredge depth condition in the entrance on 17 May 1977 is shown in Figure 40. As can be seen, the south flare has taken a significant portion of the entrance shoal sand, allowing the center channel to remain at near project depth.

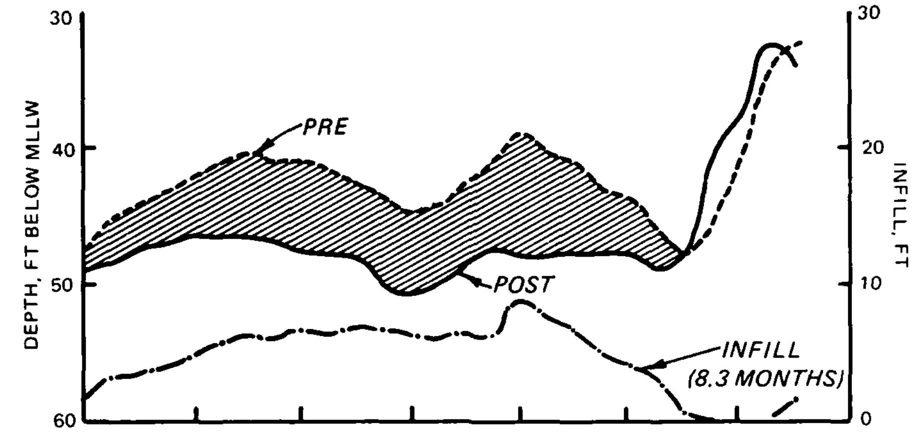


a. 45-ft project

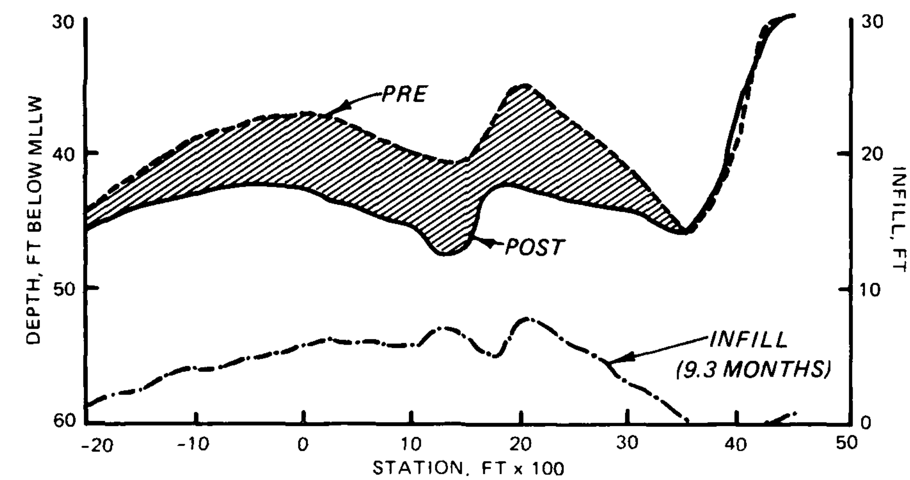


b. 40-ft project

Figure 38. Observed depths and infill rates along the south half of the Coos Bay entrance channel



a. 45-ft project



b. 40 ft-project

Figure 39. Observed depths and infill rates along the south flare of the Coos Bay entrance channel

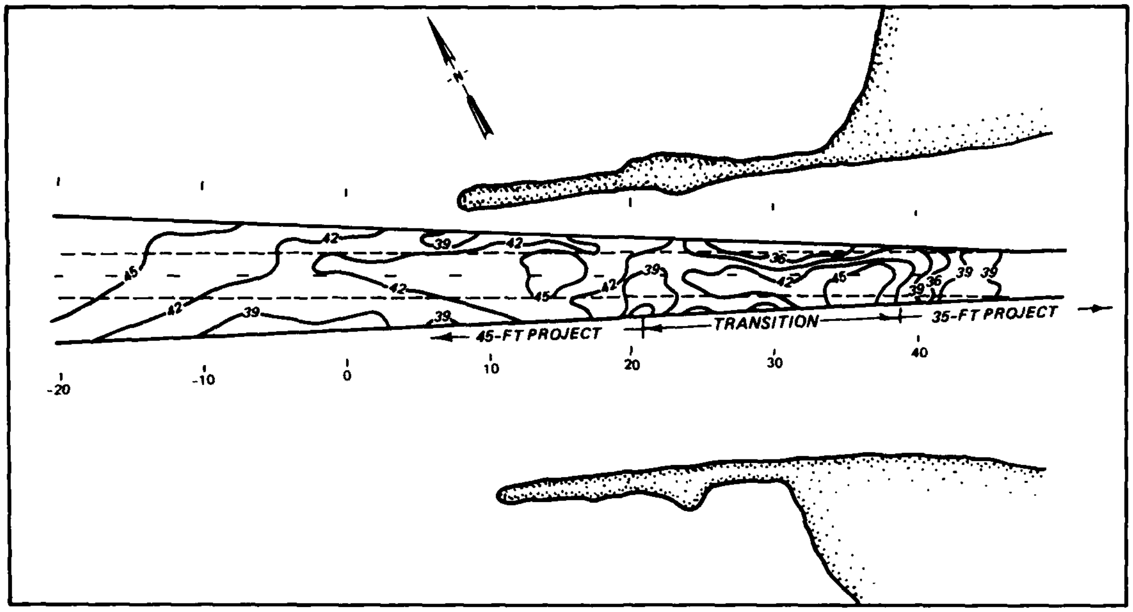


Figure 40. Coos Bay entrance channel condition on 17 May 1977

Coquille River Entrance Channel

Location and description

103. The Coquille River rises in the Coast Range of Oregon, flows generally westerly for about 100 miles to Coquille Bay, and empties into the Pacific Ocean at Bandon, Oregon (Figure 41). The entrance is 225 miles south of the mouth of the Columbia River and 420 miles north of San Francisco Bay. The main stem of the river is formed approximately 36 miles above the mouth by the confluence of the North Fork Coquille River and the South Fork Coquille River.

104. The existing project at the entrance consists of two rubble-mound, high-tide jetties (ones which have crown elevations above mllw) and a navigation channel 13 ft deep* at mllw and 200 ft wide (OCE 1983). As shown in Figure 42, the outer 2,500 ft of the channel is flared, thus increasing the width to about 740 ft at sta -20+00.

History of improvements at the entrance

105. The jetties were completed in 1908. The north jetty was

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* All depths in this part are referred to mean lower low water (mllw).

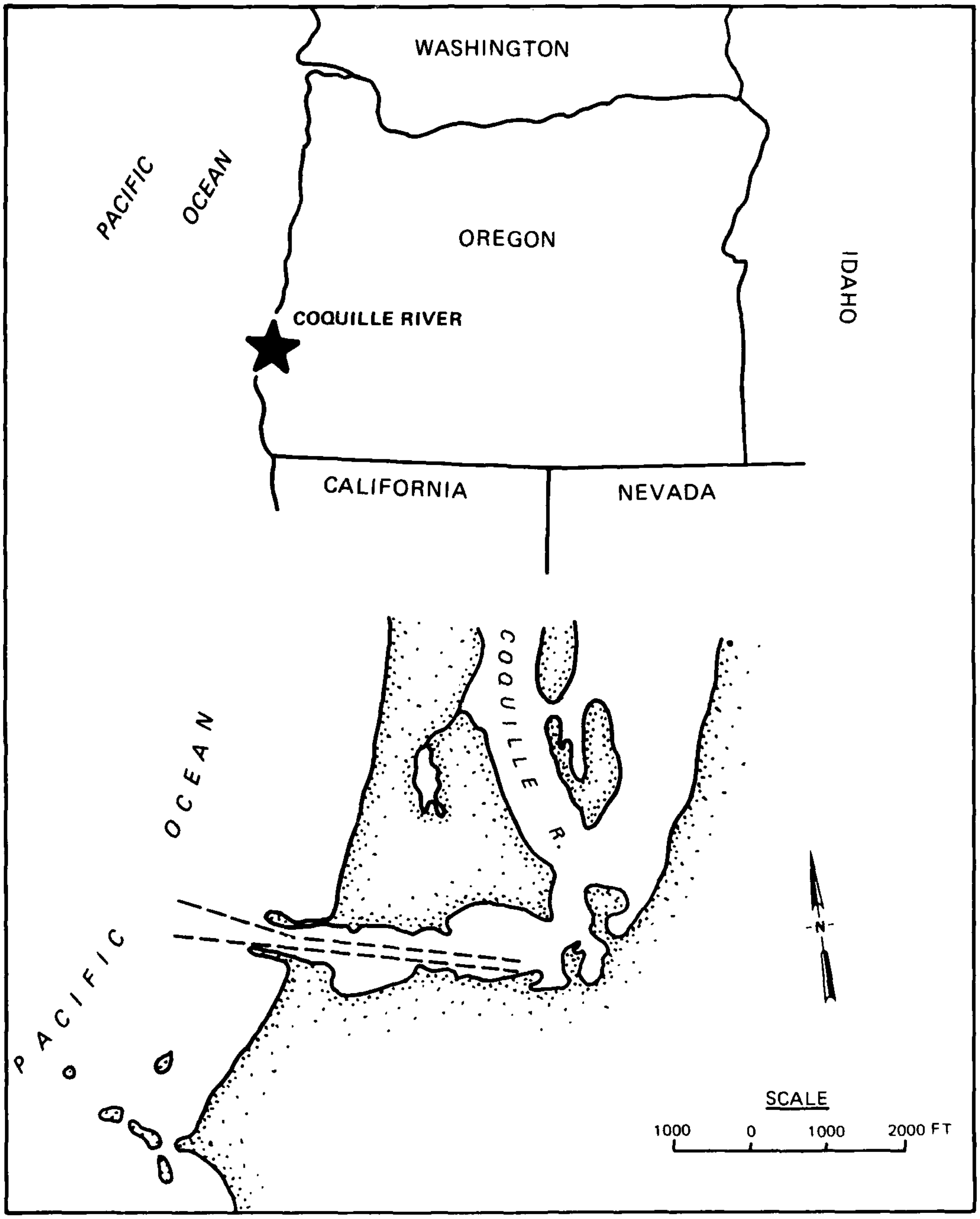


Figure 41. Coquille River, Oregon

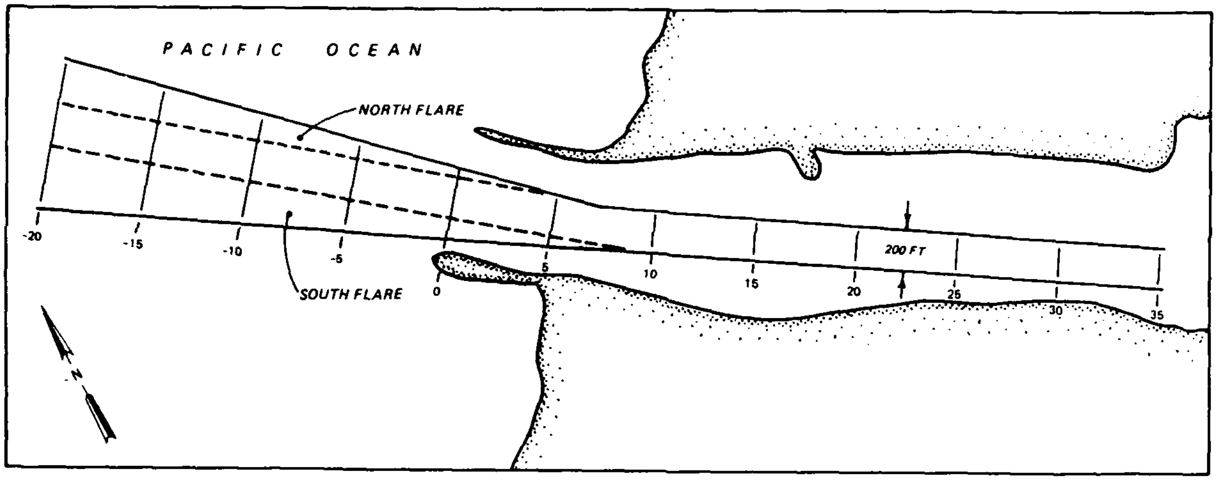


Figure 42. Coquille River entrance channel

reconstructed in 1942, and a 750-ft extension to the easterly end was constructed in 1951. The south jetty was repaired in 1954. The entrance channel was completed in 1933 (OCE 1955).

Hydraulic characteristics

106. Mean tidal range at the entrance is 5.2 ft with a corresponding tidal prism of 132 million cu ft. Diurnal range is 7.0 ft with a tidal prism of 177 million cu ft. Extreme range of tide at the entrance is 10.0 ft (Johnson 1972).

107. Maximum flood currents in the entrance channel are about 2.4 ft/sec. Maximum ebb currents are about 2.0 ft/sec (Jarrett 1976).

108. The estuary has a drainage area of 1,058 square miles. The Coquille River and its branches contribute an annual freshwater yield of 2.4 million acre-ft to the estuary. Sediments transported to the estuary each year average an estimated 100,000 tons (Percy et al. 1974).

Shoaling characteristics

109. The typical shoaling pattern of the entrance channel is shown in Figure 43. The two major shoals in the area are identified as the entrance shoal and the lighthouse shoal (USAED, Portland, 1978). The entrance shoal is skewed, with most of the shoaling towards the northern side of the channel. Lighthouse shoal is skewed slightly, with the majority of the shoaling occurring in the south half of the channel. The shoal material has a narrow grain size distribution and is fairly clean sand with a USCS classification of SP

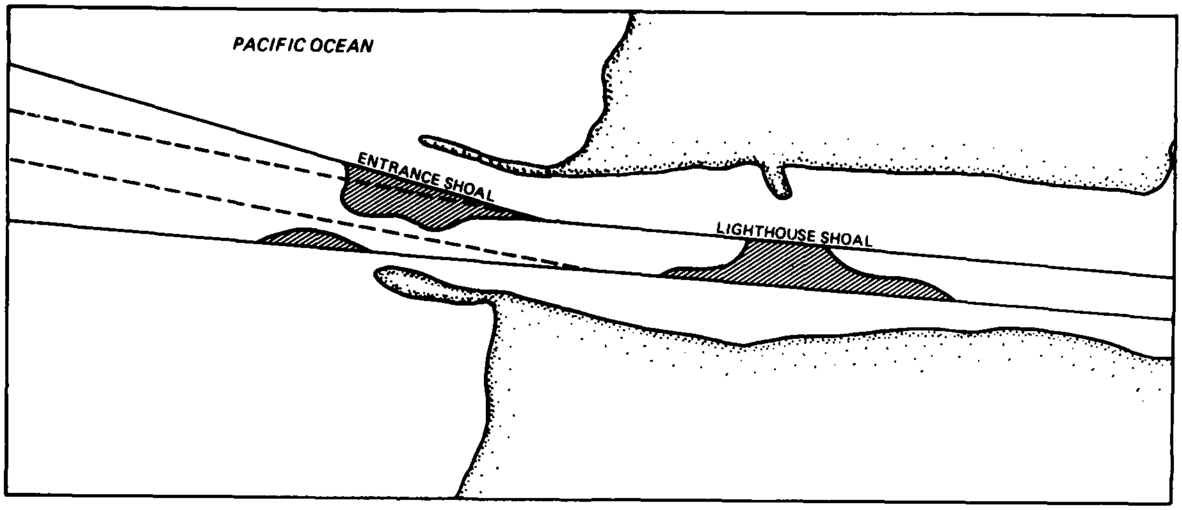


Figure 43. Typical shoaling pattern in the Coquille River entrance channel

(USAED, Portland, 1978). Net transport of sediments near Coquille appears to be to the south (Percy et al. 1974).

Results of project evaluation

110. The dredged portions of the north and south flares function as overwidth advance maintenance in that they provide areas for deposition outside the limits of the 200-ft-wide channel. An analysis of shoaling volumes and average infill rates was conducted to determine the effectiveness of these flares in trapping material which otherwise would settle in the main channel. Fifteen shoaling periods between 1962 and 1980 were included in this analysis.

111. It was necessary to select the design postdredge depth for use in the evaluation of this project because sufficient postdredge surveys were not available. The 15-ft depth selected represented the authorized depth of 13 ft plus 2 ft of allowable overdepth. If the actual postdredge depths are less than 15 ft, the actual shoaling rates are less than computed. If the actual postdredge depths are greater than 15 ft, the actual shoaling rates are greater than computed.

112. The average predredging depths at ranges taken at 250 ft intervals between sta -20+00 and 35+00 for each of the 15 shoaling periods are listed in Tables 17 and 18. The north and south flares and the north and south halves of the channel were averaged separately. The mean predredge depth, based on the mean of the 15 surveys, is also listed at each range. The data in these tables were obtained from hydrographic surveys provided by USAED, Portland.

113. The mean predredge depths in Tables 17 and 18 were used to construct representative predredge depth profiles along the north and south halves of the channel and the flared areas (Figure 44). At the entrance shoal the area of shallowest predredge depth is in the north flare, indicating that the heaviest shoaling occurs here. Predredge depth then increased across the channel to the south flare. At lighthouse shoal (ranges 15-25), the relative uniformity of the depths across the channel indicated a more even distribution of shoal material in this portion of the channel.

114. The mean predredge depths from Tables 17 and 18 were also used to develop channel infill profiles along the entrance as shown in Figure 45.

115. Integrating these profiles over distance was done to quantify the volume of material deposited annually and to establish the distribution of deposited material within the entrance area. The results are as follow:

Area	Annual Shoaling Volume Cu yd	Percent
Entrance Shoal		
North flare	3,150	53
North channel	2,220	38
South channel	370	6
South flare	190	3
Total	5,930	100
Lighthouse Shoal		
North channel	9,630	37
South channel	16,300	63
Total	25,930	100

116. As stated earlier, the flare portion of the entrance can be considered as the overwidth form of advance maintenance. The north flare appears to be effective in maintaining the channel in that 53 percent of the entrance shoal material is deposited there rather than in the main channel. The south flare contains only about 3 percent of the deposited material. Three actual shoaling patterns in the entrance are given in Figure 46 to illustrate the effectiveness of the north flare in keeping the entrance channel at project depth.

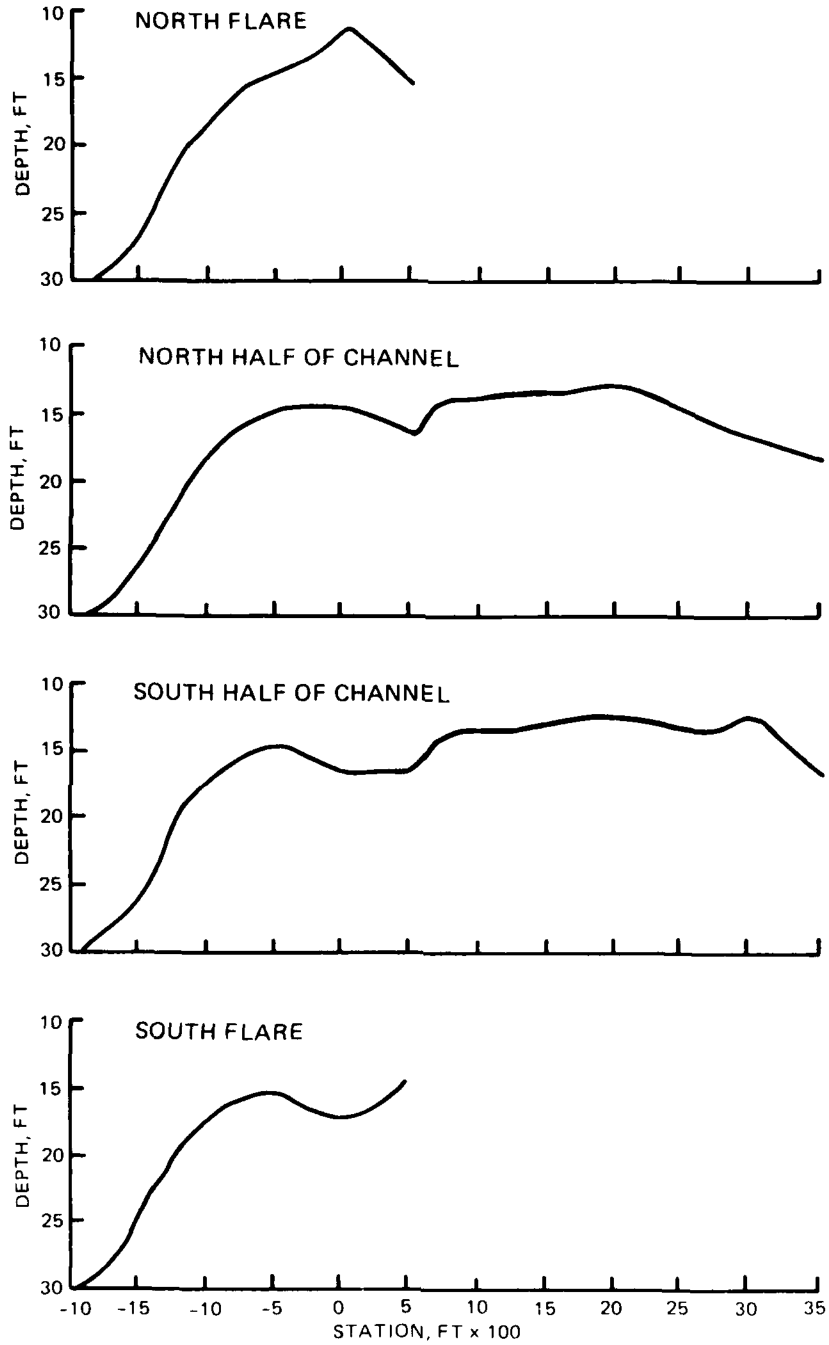


Figure 44. Representative predredge depth profiles along the Coquille River entrance channel

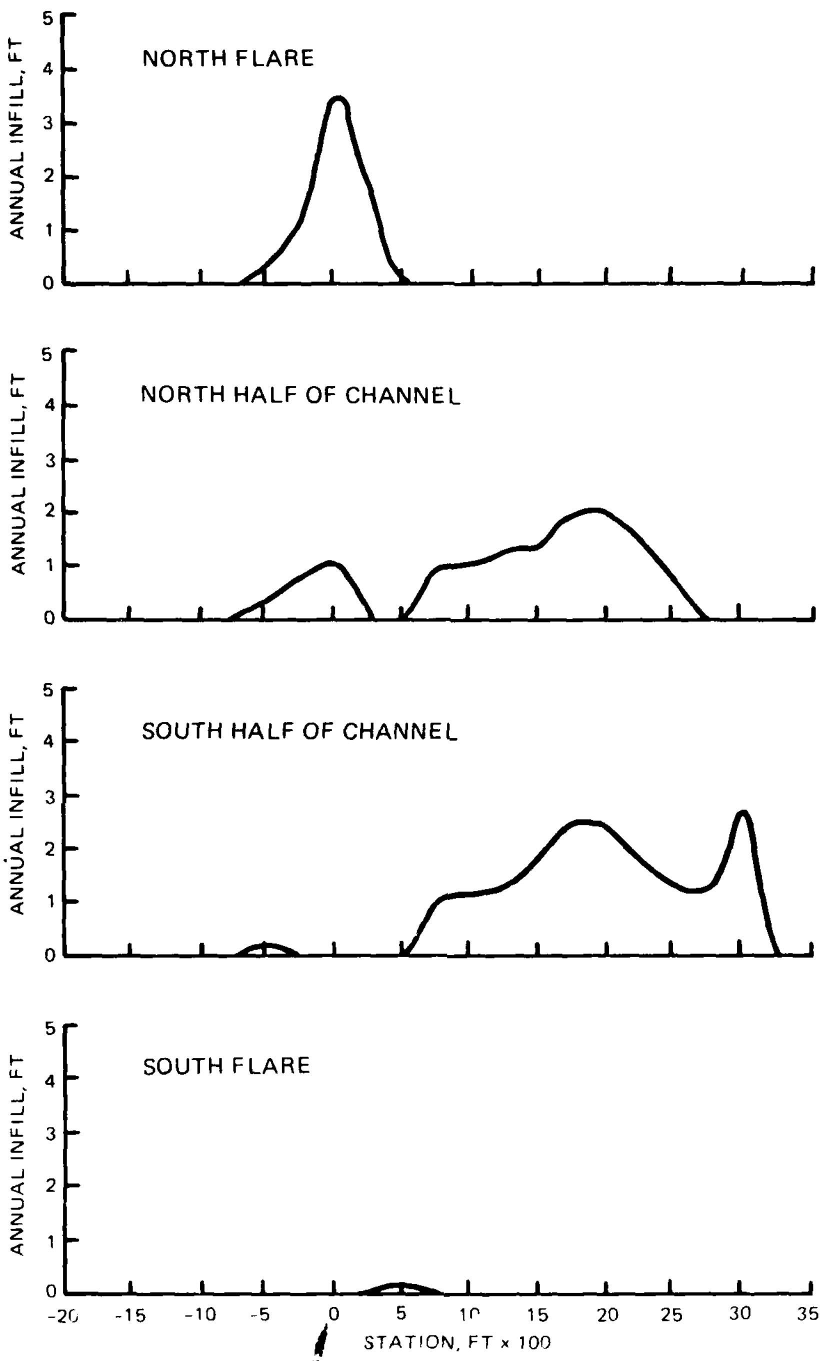


Figure 45. Coquille River entrance channel infill profiles (average annual infill)

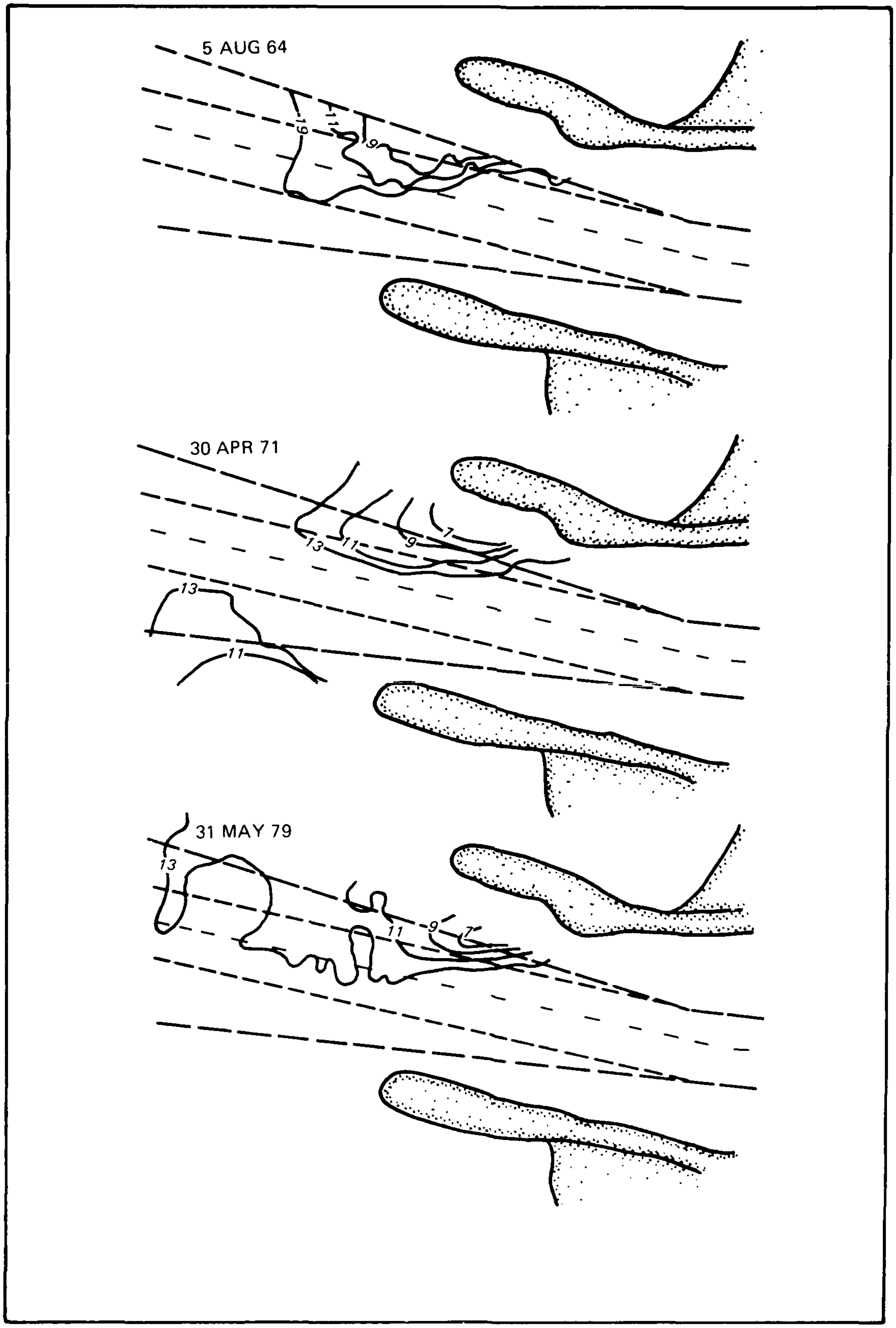


Figure 46. Actual entrance shoal patterns in the Coquille River entrance channel

Siuslaw River Entrance Channel

Location and description

117. The Siuslaw River rises in the Coast Range of Oregon, flows westerly about 110 miles, and empties into the Pacific Ocean through the entrance of Siuslaw Bay (Figure 47). Siuslaw Bay is about 160 miles south of the mouth of the Columbia River and 485 miles north of San Francisco Bay.

118. Siuslaw Bay is narrow and crooked, consisting primarily of the lower reaches of the Siuslaw River, which has its 0 mile at the mouth of the estuary.

119. The existing project at the entrance provides for two rubble-mound high-tide jetties and an entrance channel 18 ft deep at mllw and 300 ft wide from deep water in the ocean to a point 1,500 ft inside the outer end of the north jetty; thence a channel 16 ft deep, 200 ft wide, widened at the bends, and about 5 miles long to a turning basin at Florence, Oregon (OCE 1983). The entrance channel portion of the project is shown in Figure 48.

120. A modification of the existing project is currently under construction. This modification consists of extensions to both jetties and the construction of spur jetties on each extension. The purpose of the modification is to prevent longshore currents from transporting shoal material around the ends of the jetties (OCE 1983). This modification was not in effect during the period (1964-1982) covered in this study.

History of improvements at the entrance

121. The jetties were completed in 1917. The north jetty was rehabilitated in 1958; the south jetty, in 1962. A 12-ft-deep by 200-ft-wide entrance channel was completed in 1930 (OCE 1977). The channel was considered adequate for navigation and no maintenance dredging was done until 1955. At that time, 246,000 cu yd of material were removed from the entrance channel by dredging. Regular channel maintenance began in 1959. Enlargement of the channel to 18 ft deep and 300 ft wide was accomplished between August 1968 and September 1969 (OCE 1977).

Hydraulic characteristics

122. Mean tidal range at the entrance is 5.2 ft with a corresponding tidal prism of 276 million cu ft. Diurnal range is 6.9 ft with a tidal prism

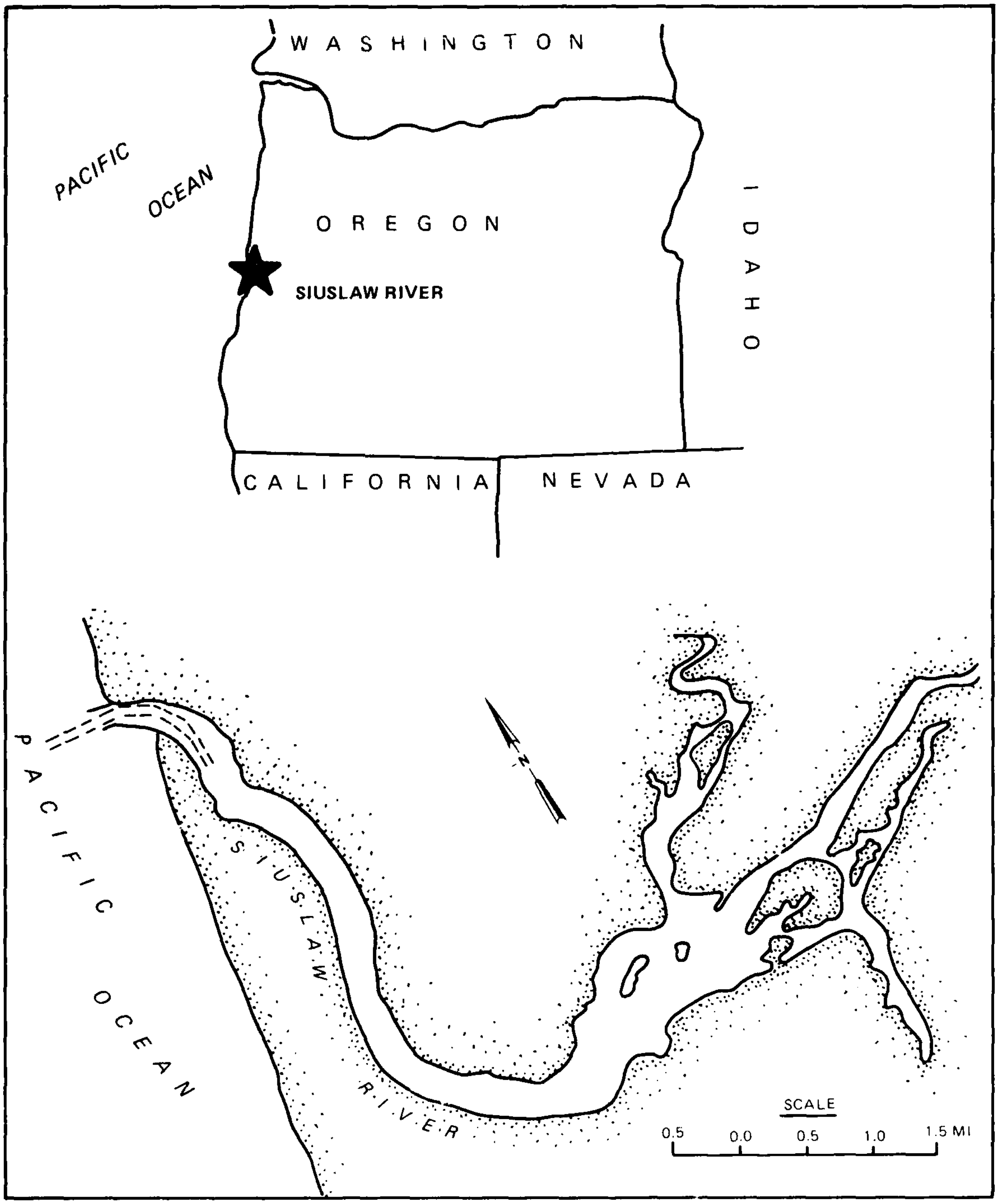


Figure 47. Siuslaw River, Oregon

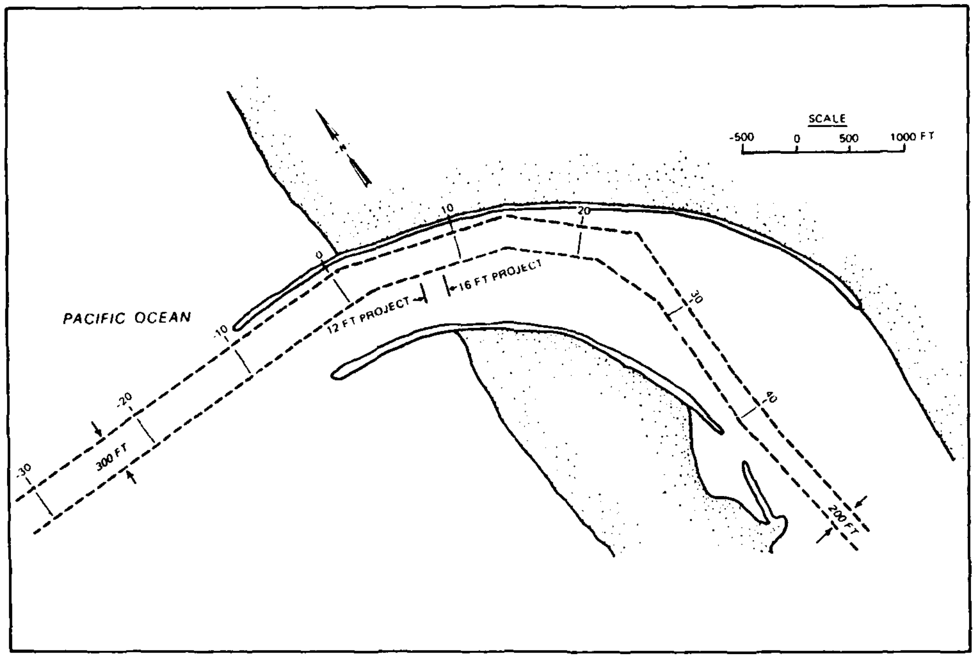


Figure 48. Siuslaw River entrance channel

of 366 million cu ft. Extreme range of tide at the entrance is 11.0 ft (Johnson 1972).

123. Maximum flood currents in the entrance channel are about 1.5 ft/sec. Maximum ebb currents are about 1.9 ft/sec (Jarrett 1976).

124. The drainage basin of the Siuslaw River is 773 square miles, which yields an annual average of 2.3 million acre-ft of fresh water. It is estimated the Siuslaw River transports some 103,000 tons of sediment to the estuary annually (Percy et al. 1974).

Shoaling characteristics

125. The typical shoaling pattern of the entrance channel is shown in Figure 49. There are four primary shoaling areas which normally require maintenance. The entrance and south jetty shoals build during the late winter and spring months. The inside and south turn shoals are related more to river flood stages (USAED, Portland, 1978). Shoal material is mostly sand (SP) of coastal origin.

Results of project evaluation

126. Rehabilitation of the south jetty, completed in December 1962, appeared to cause a major shift in the inner jetty channel alignment and a deepening of several feet along the mid-jetty to inner jetty portion of the channel. For this reason, data prior to 1964 were not used in this study.

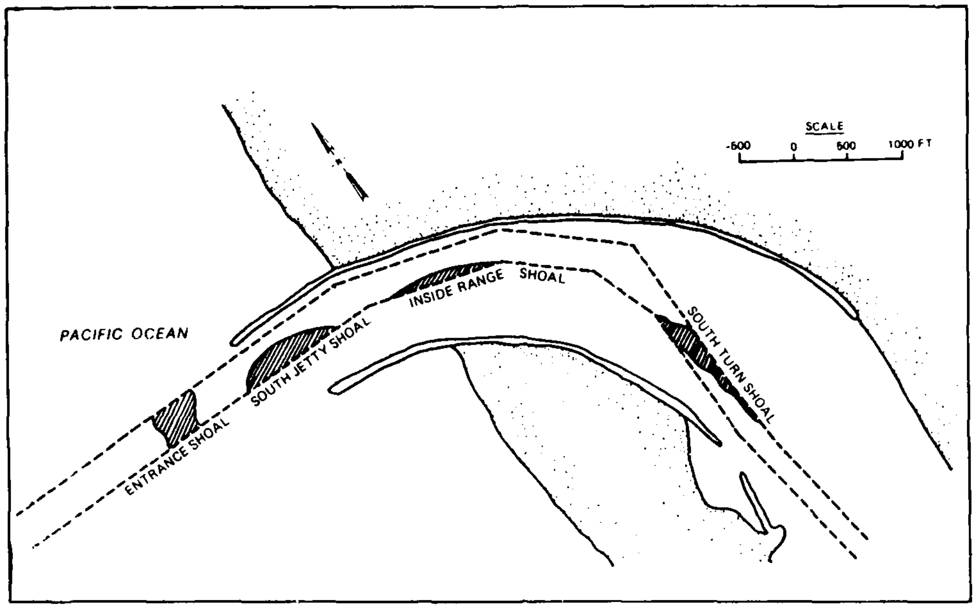


Figure 49. Typical shoaling pattern in the Siuslaw River entrance channel

127. As with the Coquille River shoaling analysis, it was necessary to select the design postdredge depths for the Siuslaw 12- and 18-ft projects because sufficient postdredge surveys were not available. For each project the authorized depth plus 2 ft of allowable overdepth was used as the postdredge depth.

128. Table 19 lists average predredge depths at 29 channel ranges taken 250 ft apart between sta -30+00 and 40+00 for each of 5 shoaling periods from 1964-1968 for the 12-ft project. The north and south halves of the channel were examined separately. The mean predredge depth of the overall period is also listed at each range.

129. Table 20 lists similar data for 12 shoaling periods between 1970 and 1982 for the 18-ft project. Depths given in both tables were based on hydrographic survey maps acquired from USAED, Portland.

130. Representative predredge depth profiles along the north and south halves of the entrance channel for both projects are shown in Figure 50. The profiles were based on the mean depths in Tables 19 and 20. The majority of the infill occurred along the south half of the channel while the north half remained quite deep along the jetty portion of the entrance.

131. Average annual infill profiles for both projects, shown in Figure 51, also were constructed from the mean predredge depths in Tables 19 and 20. For both projects, shoaling was greater for the 18-ft project especially

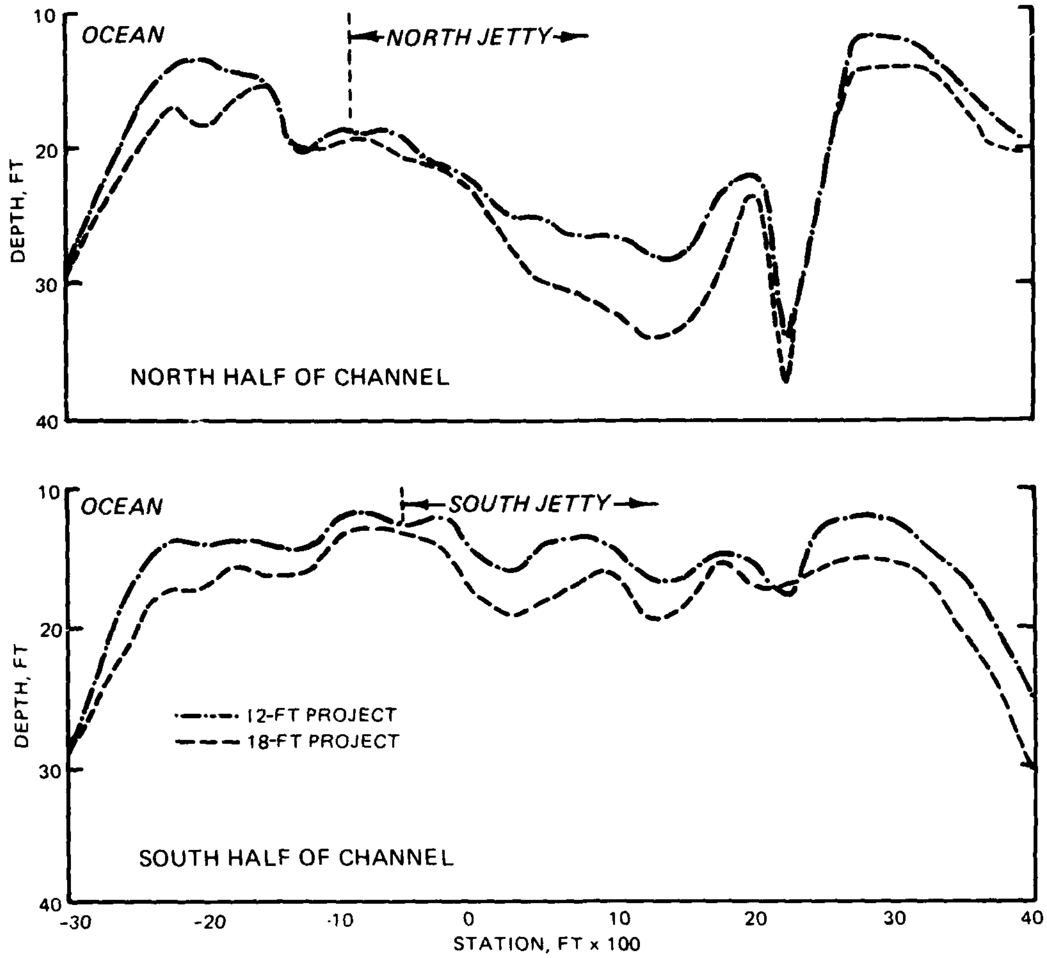


Figure 50. Representative predredge depth profiles along the Siuslaw River entrance channel

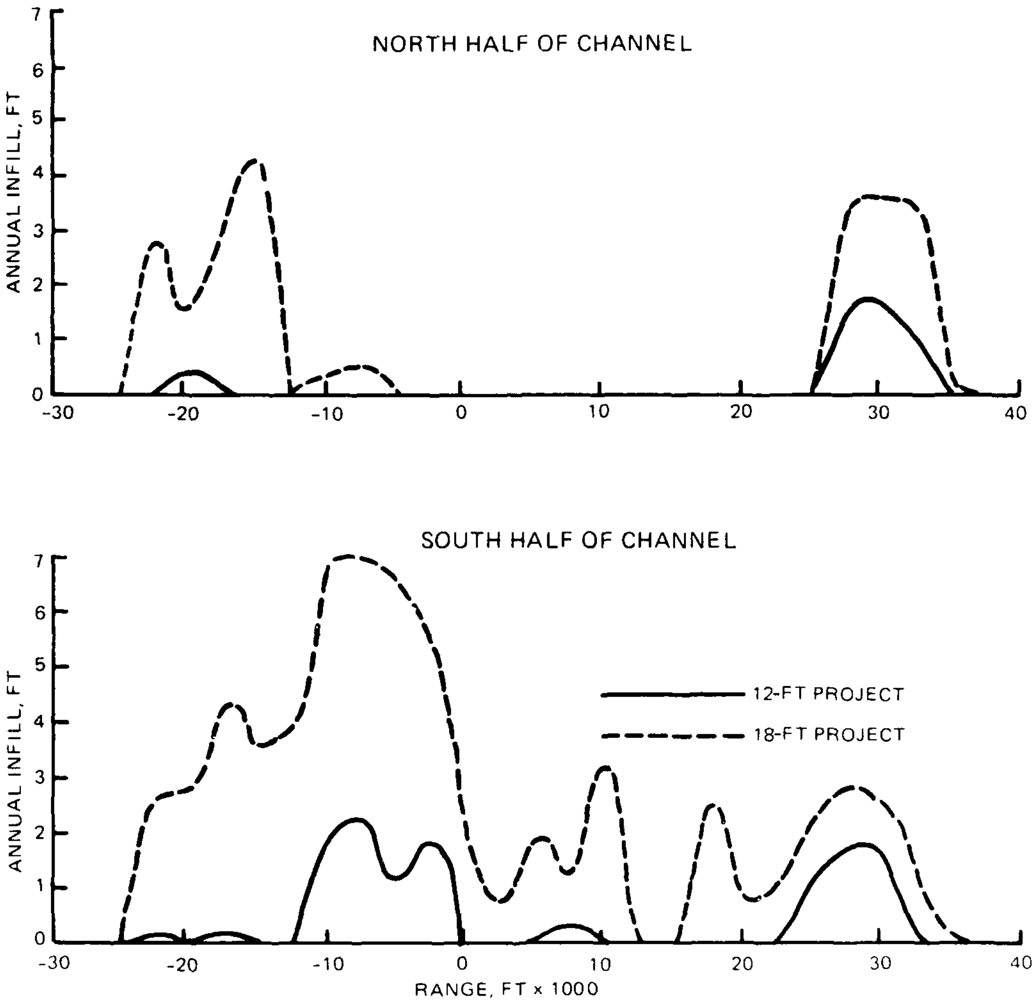


Figure 51. Average annual infill along the Siuslaw River entrance channel

at the entrance and south jetty shoals (ranges -25 to 0).

132. The infill profiles in Figure 51 were integrated to determine corresponding volumes of material to quantitatively establish the impact of deepening on annual maintenance requirements. The computed volumes, as well as reported dredging volumes from the Corps Annual Report during 1964-1982 are given as follows:

	Average Annual Shoaling Volume, cu yd		
Source of Data	12-ft Project	18-ft Project	Percent Increase
Annual Reports	90,000	185,000	106
Infill Profile	42,000	155,000	269

133. Even though both the reported dredging volumes and the infill profiles indicated greatly increased shoaling caused by the deepening, the results are quite dissimilar.

134. The Annual Report volumes are significantly greater than the volumes computed from the infill profiles because they include dredging activity upstream of the entrance area specified in this investigation.

135. Another difference is that the percent increase for the infill profile is much greater (269 percent) than that for the Annual Report volumes (106 percent). Again, because the reported volumes include dredging activity beyond that portion evaluated in this study, the actual increase caused by the deepening is probably closer to 269 percent than 106 percent.

136. Because the 18-ft project is allowed to shoal to depths similar to those which existed for the 12-ft project, the 18-ft project could be considered as equivalent to the 12-ft project with 6 ft of advance maintenance rather than a true deepening to 18 ft. The only apparent problem with this approach is that the 12-ft project was only 200 ft wide across the ocean bar; while the 18-ft project is 300 ft wide across the ocean bar, then narrowing from 300 to 200 ft between the jetties. However, during the analysis of the hydrographic surveys, it was observed that the widened portion (taken north of the 200-ft-wide channel) would not have required any significant amount of dredging if it were included in the 12-ft project. Consequently, the full 300-ft-wide ocean bar channels were included in both the 12- and 18-ft projects analyses, making them directly comparable. In summary, the large increases in shoaling observed from the comparison show that the application of advance maintenance would be costly in this case.

Yaquina Bay Entrance Channel

Location and description

137. The Yaquina Bay entrance channel is located on the Pacific coast of Oregon. It is approximately 113 miles south of the mouth of the Columbia River and 87 miles north of Coos Bay, Oregon (Figure 52).

138. The existing project at the entrance consists of two rubble-mound high-tide jetties with a spur jetty and five groins extending channelward from the south jetty; an entrance channel 40 ft deep at mllw and 400 ft wide across the outer bar to sta -10+00. Between sta -10+00 and 00+00 (mile 0) the dimensions gradually reduce to a depth of 30 ft and a width of 300 ft. These dimensions extend to a turning basin located at mile 2 (Figure 52).

History of improvements at the entrance

139. The south jetty was constructed in 1889. Extension of this jetty, and construction of the groins and a north jetty were completed in 1895. The project has undergone several modifications including extending the jetties and constructing the spur jetty. The present north jetty length of 7,000 ft was completed in 1966 and the south jetty was extended to 8,600 ft in 1972. The entrance channel was dredged to a depth of 26 ft and width of 300 ft (Figure 53a) in 1952. The 40- by 400-ft channel (Figure 53b) was completed in 1968 (OCE 1983).

Hydraulic characteristics

140. Mean tidal range at the entrance is 5.9 ft with a corresponding tidal prism of 835 million cu ft. Diurnal range is 7.9 ft with a tidal prism of 1.2 billion cu ft. Extreme range of tide at the entrance is 11.5 ft (Johnson 1972).

141. Maximum flood currents in the entrance channel are about 4.1 ft/sec. Maximum ebb currents are about 3.9 ft/sec (Jarrett 1976).

142. Yaquina River, the major tributary of the estuary, is about 59 miles in length and drains approximately 253 square miles. This drainage basin yields an average of 780,000 acre-ft of fresh water annually (Percy et al. 1974).

143. Sediments deposited in the bay each year by its tributaries total an estimated 30,000 tons (Percy et al. 1974).

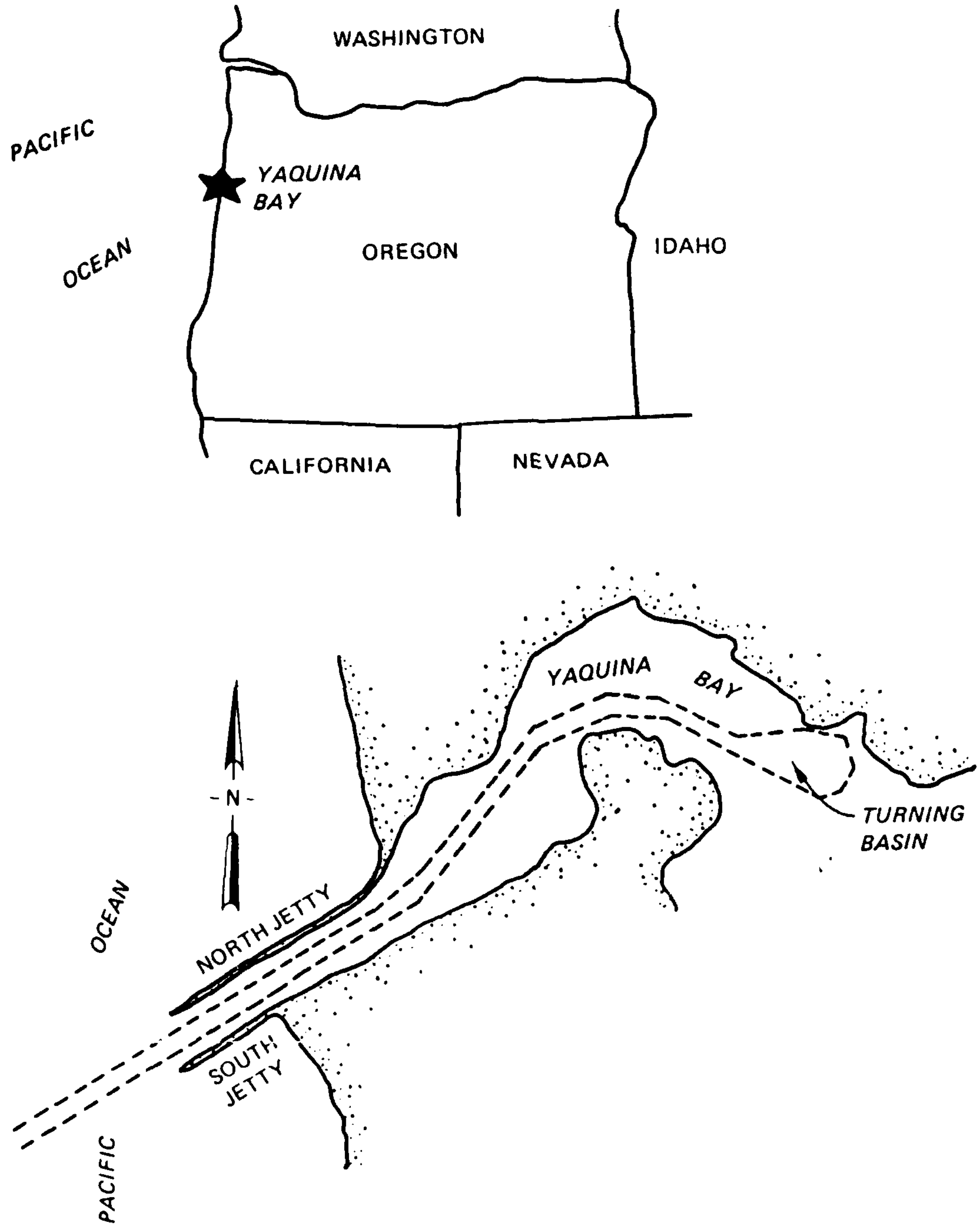
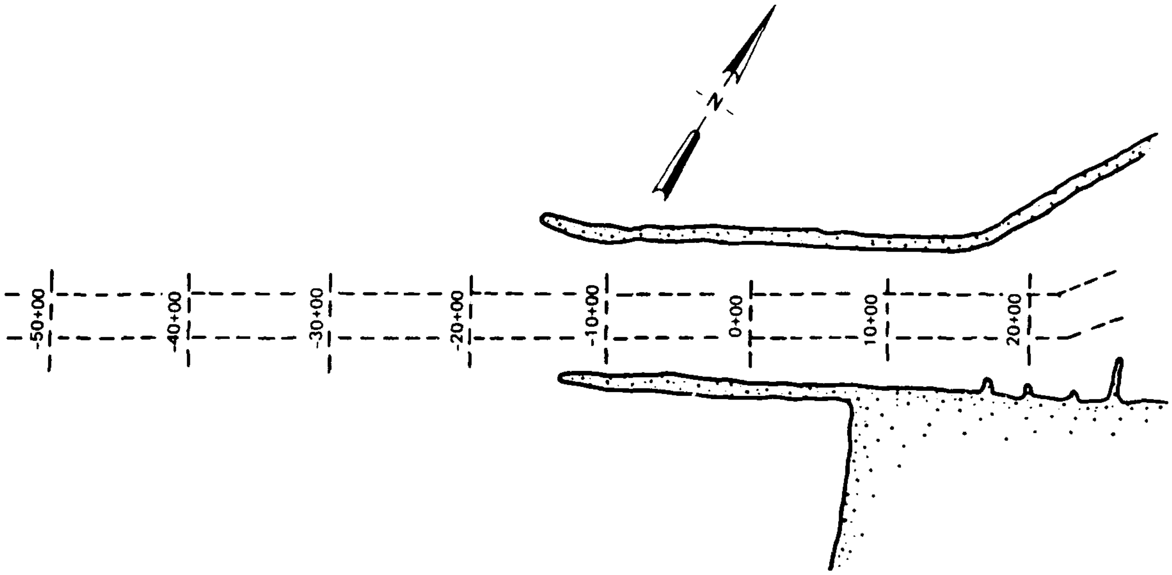
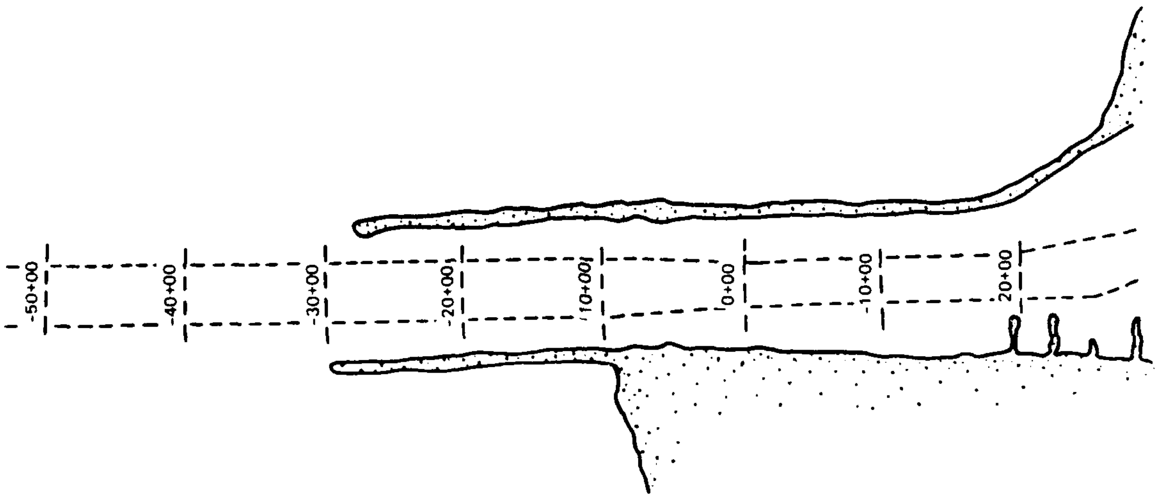


Figure 52. Yaquina Bay, Oregon



a. 26- by 30-ft project



b. 40- by 400-ft project

Figure 53. Previous and existing projects, Yaquina Bay entrance channel

Shoaling characteristics

144. The typical shoaling pattern of the entrance channel is shown in Figure 54. Two cross-channel shoals develop in the entrance. The entrance shoal builds during the winter and spring months off the ends of the jetties between ranges -28+00 and -40+00. The rocky shoal is common along the outer quarters to center line between sta 2+00 and 20+00. Sand is the predominant shoaling material (USAED, Portland, 1978).

145. Littoral transport near the Yaquina Bay entrance is northward in winter and southward in summer. The dominant transport is to the north (Percy et al. 1974).

Results of project evaluation

146. Shoaling volumes in the entrance channel were determined by comparing predredge depths with preceding postdredge depths extracted from hydrographic survey maps acquired from USAED, Portland.

147. For the 26- by 300-ft project, eight shoaling periods between June 1955 and May 1966 were analyzed. These varied in length between 7.0 and 9.3 months, with the average shoaling period being 8.1 months. Four shoaling periods between August 1972 and June 1977 were analyzed for the 40- by 400-ft project. These varied in length between 7.4 and 10.2 months, with the average shoaling period being 8.6 months. For comparison, infill rates and shoaling volumes for both projects were converted to annual rates.

148. Because shoaling is seldom uniform over the entire width or length of a channel, the north and south halves of the Yaquina Bay entrance channel

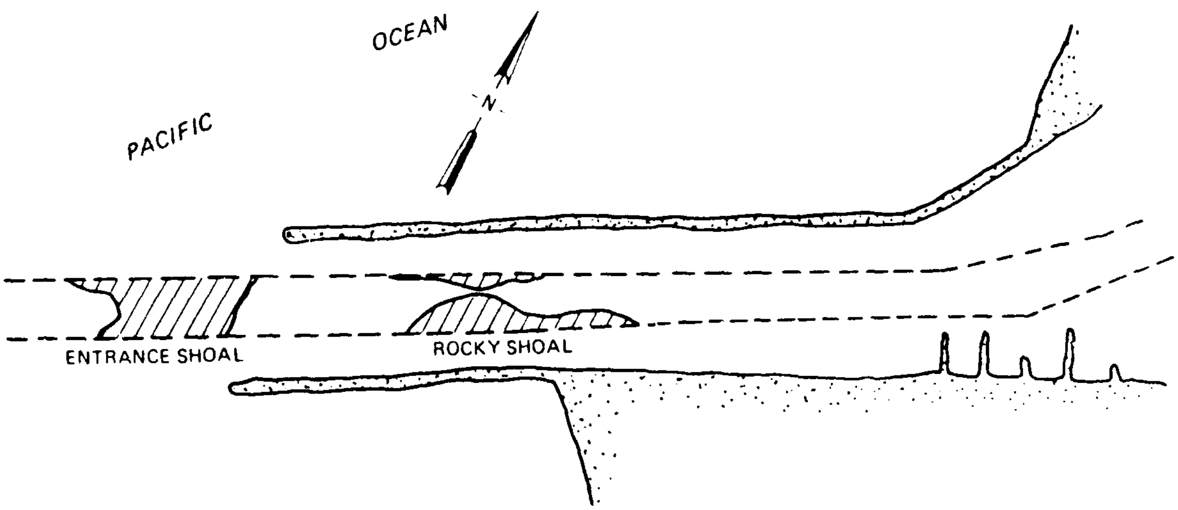
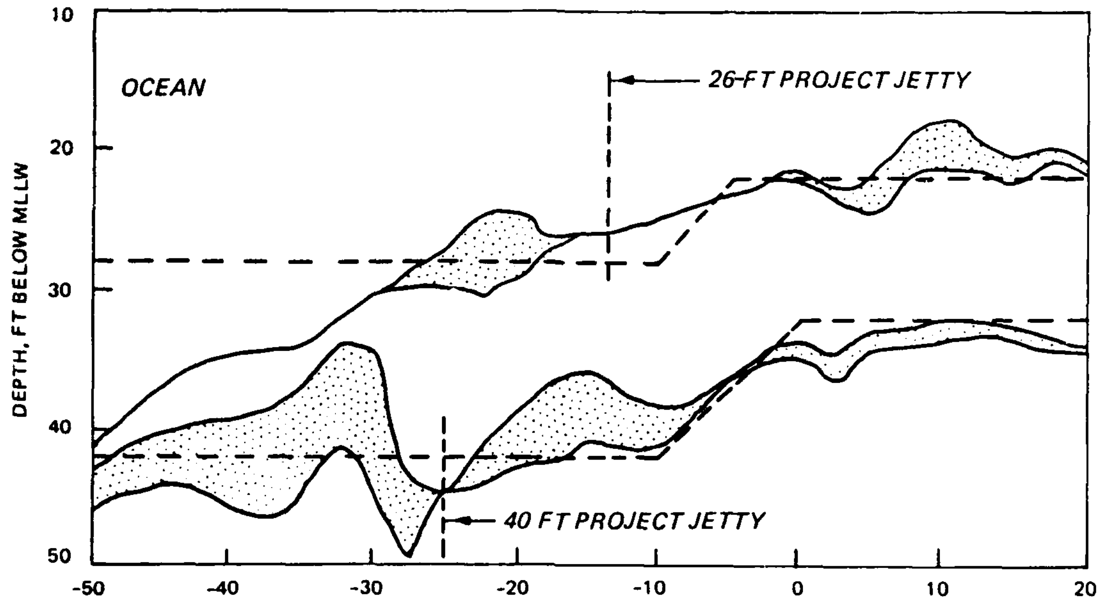
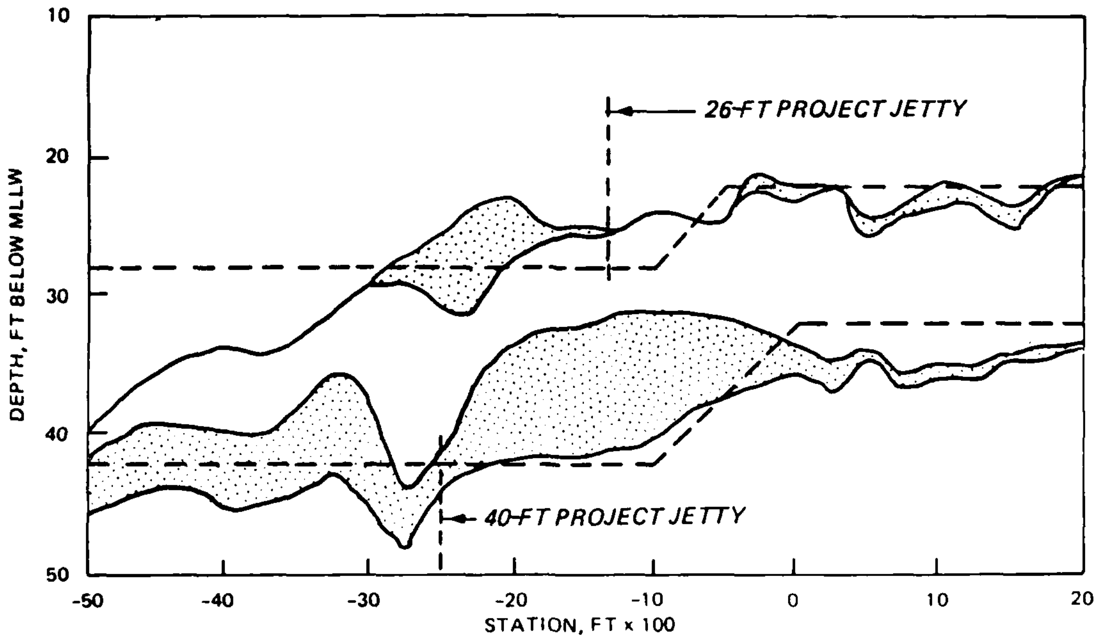


Figure 54. Typical shoaling pattern in the Yaquina Bay entrance channel



a. North half of channel



b. South half of channel

Figure 55. Infill profiles along the Yaquina Bay entrance channel

were evaluated separately. The entire channel from range -50+00 to range +20+00 was discretized to form four sections for each half of the channel.

149. Average depths across both halves of the channel were computed at 250-ft increments for each hydrographic survey used in the study. These depths are presented in Tables 21-24 as are the mean depths for all the predredge and postdredge surveys.

150. Average shoaling profiles for both projects are shown in Figure 55.

151. The computed volume and distribution of shoaling for the 26- by 300-ft project are compared with that of the 40- by 400-ft project as follows:

Channel		26- by 300-ft Project		40- by 400-ft Project	
Section	Half	Volume 1,000 cu yd	Distribution percent	Volume 1,000 cu yd	Distribution percent
-50 to -30	North	00	00	125	22
	South	02	02	111	19
-30 to -10	North	28	24	94	16
	South	41	35	152	26
-10 to 0+00	North	01	00	09	02
	South	03	02	50	09
0+00 to +20	North	29	25	17	03
	South	14	12	16	03
Subtotal	North	58	49	245	43
	South	60	51	329	57
Total		118	100	574	100

152. Analysis of the shoaling characteristics of the Yaquina Bay entrance channel by sections indicates an overall increase of approximately 386 percent in the average annual shoaling volume of the 40- by 400-ft project over that of the 26- by 300-ft project.

153. Approximately 41 percent of this increased volume (236,000 cu yd) occurred in the outer 2,000 ft of the project between ranges -50+00 and -30+00. The predredge depths for this portion of the 26- by 300-ft project (Tables 21 and 22) indicate little, if any, maintenance dredging was required. The average predredge depth for this area was 34.7 ft--much greater than the authorized project depth of 26 ft. The postdredge depth averaged 34.0 ft, indicating a rather stable condition in this portion of the channel. For the 40- by 400-ft project, the average postdredge depth was 44.5 ft, and the average predredge depth was 38.8 ft. This indicates that the 5 ft of advance

maintenance authorized is being dredged, and the channel is attempting to return to a state of equilibrium at 34-35 ft.

154. The portion of the channel between ranges -30+00 and -10+00 was the area of highest shoaling for both projects. For the 26- by 300-ft project it accounted for 59 percent of the total volume as compared to only 2 percent for the section from -30+00 to -50+00. The 40- by 400-ft project showed a more even distribution of the shoaling in the two areas with 42 percent of the total channel shoaling volume occurring between ranges -10+00 and -30+00, and 41 percent between -30+00 and -50+00.

155. The transitional zone of the channel from -10+00 to 0+00 (where channel dimensions were gradually reduced for both projects) showed no significant shoaling, with the exception of the south half of the 40- by 400-ft channel where approximately 50,000 cu yd (9 percent of the total) occurred.

156. The inner portion of the channel, ranges 0+00 to 20+00, showed a decrease of about 10,000 cu yd in shoaling volume from the 26- by 300-ft to the 40- by 400-ft project.

157. In summary, the large overall increase in shoaling resulting from the enlarged project indicates that advance maintenance is costly in this case.

PART V: CONCLUSIONS

Atlantic Coast Projects

158. In the Wilmington Harbor entrance channel, the increase in project dimensions from 35 ft deep to 40 ft deep and from 400 ft wide to 500 ft wide resulted in only a minor increase in entrance shoaling, averaging only 5 percent. This fact suggests that advance maintenance could be effective along this entrance channel since the additional depth should not result in significantly increased shoaling. The application of 3 to 5 ft of advance maintenance along the heaviest shoaling portion of the entrance channel, from sta 10+000 to sta 20+000, should result in maintaining project depth a greater percent of time and possibly even reducing the required dredging frequency.

159. For the Lynnhaven Inlet entrance channel, the history of the overwidth advance maintenance dredging activity since 1965 was reviewed. Although there were not sufficient data to quantitatively evaluate the effectiveness of the applied overwidth advance maintenance, the fact that either the channel alignment or the location of advance maintenance was changed each dredging cycle suggested that the problem shoaling areas were continuously shifting.

160. For the Savannah Harbor entrance channel, a small increase in shoaling volume (7 to 10 percent) was observed for the deeper and wider channel. Although the data base was rather sparse, it does suggest that advance maintenance dredging could be effective in improving the project without any substantial increase in overall maintenance dredging volumes.

Gulf Coast Projects

161. In the Mississippi Sound portion of the Gulfport Harbor entrance channel, the hydrographic survey data indicate that the channel shoaling rates are not sensitive to channel depth. This fact was demonstrated by USAED, Mobile, during a 1964 field test, when a large section of the sound channel was overdredged by 10 ft. The resulting shoaling rate was about the same as before the overdepth dredging. Recently, USAED, Mobile, increased the advance maintenance in the Gulfport Harbor channel from 2 to 4 ft, but the channel's shoaling response to the additional advance maintenance has not yet been established. However, based on the data that were evaluated, the advance

maintenance should be effective in improving the depth assurance index and also reducing the required dredging frequency.

162. Based on the limited data available, the Pascagoula Harbor entrance channel overwidth dredging is an effective means of keeping the navigation channel along this reach from becoming shoaled in by littoral transport long before the next dredging cycle.

163. For the outer bar portion of the Galveston Harbor entrance channel from 1958 through 1964, the comparison of shoaling with 2 ft of advance maintenance and without advance maintenance showed no obvious increase in shoaling volumes. The evaluation, although limited, does support the idea that a more ambitious advance maintenance program in the entrance might be effective.

Pacific Coast Projects

164. In the Coos Bay entrance channel, the deepened channel showed a significant increase in shoaling volume. Specifically, a 5-ft channel deepening from 40 to 45 ft resulted in a 40 percent increase in overall volumetric shoaling rate. The flared entrance, which can be considered as overwidth advance maintenance, appears to be effective in significantly improving the depth assurance index. The flare portion of the entrance channel accounted for about 43 percent of the sand deposition in the entrance.

165. In the Coquille River entrance channel, the flared entrance appeared to be an effective means for significantly improving the depth assurance index. The flare portion of the entrance accounted for about 56 percent of the sand deposition in the entrance.

166. The conclusions reached from the analysis of the Siuslaw River entrance channel shoaling are that (a) the 6-ft deepening to 18 ft has behaved more like 6 ft of advance maintenance added to the 12-ft project rather than a true deepening of the project to 18 ft because of the greatly increased shoaling rates associated with the deepening and no accompanying increase in the maintenance dredging frequency, and (b) treated as a comparison of a 12-ft project with little or no advance maintenance to a 12-ft project with 6 ft of advance maintenance, the overdepth dredging could be costly in that the required dredging volume increased 269 percent.

167. In the case of the Yaquina Bay entrance channel, the analysis showed that after the project was deepened from 26 to 40 ft and widened from

300 to 400 ft, the entrance dredging requirement suffered a 386 percent increase. That fact demonstrates that advance maintenance in the entrance could be very costly in terms of increased maintenance dredging volumes.

168. The conclusions are summarized regarding advance maintenance effectiveness for each of the projects evaluated in the following tabulation:

Project	Analysis of	Data Base	Conclusion
Wilmington Harbor entrance channel	Channel enlargement	Extensive	Potential for effective use of advance maintenance exists
Lynnhaven Inlet entrance channel	Overwidth advance maintenance	Limited	Results are inconclusive
Savannah Harbor entrance channel	Channel enlargement	Limited	Potential for effective use of advance maintenance exists
Gulfport Harbor sound channel	Overdepth advance maintenance	Fairly extensive	The overdepth advance maintenance program is effective and has recently been expanded
Pascagoula Harbor entrance channel	Overwidth advance maintenance	Limited	The overwidth advance maintenance is effective in keeping channel open to navigation
Galveston Harbor outer bar channel	Overdepth advance maintenance	Limited	The advance maintenance is effective. Could be expanded
Coos Bay entrance channel	Channel deepening, overwidth advance maintenance	Extensive	The overwidth advance maintenance (flaring) is effective in keeping channel open. Overdepth advance maintenance maybe effective but burdened due to increased shoaling rates
Coquille River entrance channel	Overwidth advance maintenance	Extensive	The overwidth advance maintenance (flaring) is effective in keeping channel open to navigation
Siuslaw River entrance channel	Channel enlargement	Extensive	Overdepth advance maintenance is costly due to increased shoaling rates
Yaquina Bay entrance channel	Channel enlargement	Extensive	Advance maintenance is costly due to increased shoaling rates.

PART VI: RECOMMENDATIONS

169. Based on the analyses of the projects discussed in this report, the following recommendations for the use of advance maintenance in entrance channels are as follows.

a. In projects where the infill rates are not sensitive to dredged depth, overdepth advance maintenance not only has the potential of increasing the percent of time that economic depths are maintained (depth assurance index), but also of reducing the required dredging frequency. Advance maintenance greater than 2 ft should be considered for this type of entrance channel. Consideration of 3-6 ft of advance maintenance is recommended.

b. In projects where the infill rate is sensitive to dredged depth, overdepth advance maintenance does increase the percent of time economic depths are maintained (depth assurance index), but at a cost. In this type of entrance channel, overdepth advance maintenance causes an increase in the overall maintenance dredged volume. The required maintenance dredging frequency probably will not be reduced. The minimum acceptable percent of time that the economic depth must be maintained should first be determined, and then the amount of overdepth advance maintenance required to achieve that minimum should be estimated. The greater the advance maintenance required, the greater will be the overall maintenance dredging costs.

c. When considering overwidth advance maintenance in entrance channels, a good rule-of-thumb is that the overwidth section should be at least one-half the width of the navigation channel to provide adequate storage volume and should be limited to the channel reach in which problem shoaling occurs. Overwidth advance maintenance is most applicable in cases where the location of the problem shoal areas is consistent from season to season. If the shoal areas shift from season to season, overwidth advance maintenance probably cannot be effectively applied.

d. In all cases where an advance maintenance program is being considered, an evaluation of project shoaling behavior, such as presented in this report, should be conducted before an advance maintenance program is designed.

e. Once an advance maintenance program is underway, a continuing evaluation of its performance, including documentation, should be an integral part of the program. In this way an unsuccessful application can be revised or terminated and successful programs can be enhanced.

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Table 1

Wilmington Harbor Entrance Channel, 35-ft Project

Predredge and Postdredge Survey Depths

Northwest Half of Channel

Range*	Survey Depth, ft, at Indicated Date of Survey: 6 Dec 60	15 Dec 61	6 Mar 63	4 Aug 64	12 Aug 65	5 Aug 66	21 Nov 67	Mean	Average Infill, ft
					Predredge				
0	37.0	36.0	37.3	38.0	37.3	40.3	38.3	37.7	-0.6
	40.7	41.3	45.3	41.7	45.0	45.0	42.0	43.0	-1.5
1	45.7	47.3	48.0	50.3	50.0	50.7	52.0	49.1	0.4
	48.0	43.3	44.7	44.0	44.3	44.0	45.0	44.8	-1.0
2	48.0	42.3	43.3	42.7	43.0	42.3	43.0	43.5	-1.3
	44.7	41.3	41.0	40.7	40.7	40.0	40.3	41.2	-0.9
3	36.3	37.7	40.0	39.3	39.3	39.0	37.0	38.4	0.0
	34.7	36.0	37.3	36.7	37.7	37.3	37.0	36.7	0.2
4	35.3	35.7	36.0	36.0	35.7	36.0	36.0	35.8	0.7
	35.3	36.0	36.3	35.0	35.7	35.0	35.0	35.5	0.5
5	35.3	36.0	37.3	35.7	36.3	36.0	35.0	35.9	1.6
	35.7	36.3	40.7	36.7	39.7	37.0	37.3	37.6	1.2
6	33.0	32.3	36.3	36.3	37.7	39.10	40.0	36.4	2.2
	32.3	32.3	34.0	33.7	35.3	38.3	40.0	35.4	2.3
7	33.7	33.7	33.3	35.3	34.7	35.7	37.7	34.9	4.5
	35.7	35.7	34.7	32.7	35.3	36.3	39.3	35.7	4.0
8	36.3	37.7	38.0	36.0	34.3	36.7	35.3	36.3	3.0
	35.3	36.7	37.3	36.3	36.3	37.7	38.7	36.9	1.2
9	34.0	35.0	36.3	35.3	35.3	36.7	38.3	35.8	1.1
	33.0	34.3	33.0	33.3	33.3	35.0	36.7	34.1	1.4
10	33.0	34.0	32.0	32.7	32.0	33.3	35.0	33.1	1.6
	33.3	34.0	32.0	32.3	32.3	32.7	34.3	33.0	2.7
11	32.7	34.0	32.0	32.0	32.3	32.7	33.7	32.8	3.2
	32.0	33.7	32.0	32.7	32.7	33.3	33.3	32.8	2.7
12	32.0	32.0	32.0	32.7	32.3	33.0	32.0	32.3	3.3
	31.7	32.0	32.0	32.0	32.3	33.0	32.0	32.1	3.6
13	31.3	32.0	31.0	31.0	32.0	32.7	31.3	31.6	4.1
	31.3	31.7	31.0	31.0	31.3	32.7	31.3	31.5	3.9
14	31.7	32.0	31.0	31.0	31.0	32.3	31.3	31.5	3.8
	31.7	32.3	31.3	31.0	31.3	32.7	31.7	31.7	4.0
15	32.0	32.7	31.7	31.0	31.3	33.3	32.3	32.0	4.4
	32.7	33.7	31.7	31.0	31.3	33.3	32.3	32.3	4.1
16	32.7	33.7	32.0	31.0	31.7	33.7	32.7	32.5	3.9
	32.3	33.7	32.3	31.3	32.0	33.7	33.0	32.6	4.2
17	32.7	33.7	32.3	31.7	32.0	34.0	33.7	32.9	4.0
	33.3	33.7	32.3	32.0	33.0	34.0	33.7	33.1	3.8
18	33.0	34.7	32.3	32.0	33.0	34.3	33.7	33.3	4.0
	33.7	34.7	32.7	32.7	33.3	35.0	34.0	33.7	3.9
19	34.7	35.0	32.7	33.3	33.7	35.0	34.0	34.1	3.1
	34.7	35.7	33.0	34.0	33.7	35.7	34.7	34.5	2.7
20	34.7	35.0	34.3	35.0	34.7	35.7	35.7	35.0	1.6
	35.3	36.0	35.0	35.7	36.0	36.3	36.0	35.8	0.5
21	35.7	36.3	36.0	36.7	37.0	37.0	36.3	36.4	0.2
	36.7	37.0	37.0	37.0	38.0	38.0	38.0	37.4	-0.1
22	--	38.3	38.0	38.0	39.0	38.7	38.7	38.5	-0.1

(Continued)

* Ranges are 500 ft apart.

Table 1 (Concluded)

Range	Survey Depth, ft, at Indicated Date of Survey: 25 Aug 59	3 Jan 61	29 Jan 62	2 Apr 63	3 Sep 64	3 Sep 65	7 Sep 66	Mean	Average Infill, ft
					Postdredge				
0	36.3	36.0	36.7	37.3	38.0	37.7	37.7	37.1	-0.6
	38.7	37.3	41.3	42.3	43.7	44.7	42.7	41.5	-1.5
1	46.3	47.3	50.7	41.3	50.7	50.3	50.0	49.5	0.4
	42.7	43.0	43.7	44.0	43.7	45.0	44.3	43.8	-1.0
2	41.3	41.3	42.7	42.3	42.0	43.0	42.7	42.2	-1.3
	39.7	40.7	41.0	40.0	40.7	40.0	40.3	40.3	-0.9
3	37.0	38.0	38.7	39.0	38.7	39.0	38.7	38.4	0.0
	37.3	36.0	36.7	37.0	36.7	37.0	37.7	36.9	0.2
4	37.3	36.0	36.7	36.0	36.7	26.7	36.0	36.5	0.7
	37.0	35.7	36.0	36.3	36.0	36.0	35.3	36.0	0.5
5	37.7	37.0	39.0	38.0	36.7	38.0	36.3	37.5	1.6
	37.7	36.7	41.7	39.7	38.7	40.7	37.3	38.9	1.2
6	38.3	36.0	40.7	42.3	40.0	41.7	39.0	39.7	2.2
	39.3	36.7	37.7	38.0	38.0	41.0	40.7	38.8	2.3
7	39.0	38.0	40.7	37.3	40.3	41.7	39.0	39.4	4.5
	38.3	39.3	41.0	38.0	37.3	42.3	41.7	39.7	4.0
8	38.0	38.0	41.3	39.7	37.0	40.3	41.0	39.3	3.0
	37.3	37.0	39.0	37.3	37.0	39.7	39.7	38.1	1.2
9	36.3	35.0	37.7	36.3	36.7	37.7	38.7	36.9	1.1
	35.7	36.3	35.7	34.3	34.0	35.3	37.0	35.5	1.4
10	35.3	35.7	35.7	33.3	32.0	34.7	36.7	34.9	1.6
	37.3	36.3	36.7	34.7	33.3	34.7	37.0	35.7	2.7
11	36.7	36.0	37.0	35.3	35.3	35.7	36.3	36.0	3.2
	35.3	34.7	36.7	35.0	34.3	35.7	36.7	35.5	2.7
12	35.7	34.7	36.3	36.0	35.7	35.3	35.7	35.6	3.3
	35.7	35.3	36.0	36.3	35.0	36.0	35.7	35.7	3.6
13	36.3	34.3	36.0	36.3	35.7	35.3	35.7	35.7	4.1
	35.7	34.0	35.3	35.7	35.3	35.3	36.7	35.4	3.9
14	35.3	35.0	35.7	36.0	35.3	34.0	35.7	35.3	3.8
	35.3	35.0	36.7	36.3	35.0	35.3	36.3	35.7	4.0
15	36.3	36.3	37.3	36.3	35.3	36.7	36.3	36.4	4.4
	37.0	36.7	36.3	37.0	35.3	35.0	37.3	36.4	4.1
16	36.7	35.7	36.7	36.7	36.3	35.7	37.3	36.4	3.9
	36.7	35.7	37.0	37.7	36.0	37.3	37.0	36.8	4.2
17	37.0	36.7	36.3	37.3	36.3	37.7	37.3	36.4	4.0
	36.3	36.3	37.0	37.7	36.3	37.3	37.3	36.9	3.8
18	37.7	36.3	37.3	37.7	37.0	37.7	37.7	37.3	4.0
	37.0	36.7	37.7	38.3	37.7	38.0	37.7	37.6	3.9
19	37.7	37.0	36.7	38.0	36.3	38.3	36.3	37.2	3.1
	38.7	36.7	36.3	36.7	37.7	38.0	36.0	37.2	2.7
20	37.0	37.0	36.3	36.3	36.7	37.0	35.7	36.6	1.6
	37.0	36.0	36.3	36.7	36.0	36.3	35.0	36.3	0.5
21	--	35.7	36.7	37.0	36.0	37.0	37.0	36.6	0.2
	--	36.0	37.7	--	37.0	38.0	38.0	37.3	-0.1
22	--	37.0	38.7	--	38.0	39.0	38.7	38.4	-0.1

Table 2

Wilmington Harbor Entrance Channel, 35-ft Project

Predredge and Postdredge Survey Depths

Southeast Half of Channel

Range*	Survey Depth, ft, at Indicated Date of Survey								Average
	6 Dec 60	15 Dec 61	6 Mar 63	4 Aug 64	12 Aug 65	5 Aug 66	21 Nov 67	Mean	Infill, ft
					Predredge				
0	37.7	37.3	37.7	39.0	41.7	40.7	41.7	39.4	-1.2
	46.0	48.0	45.7	44.7	44.0	46.3	44.0	45.5	-0.8
1	42.7	43.0	45.3	44.0	45.3	43.0	45.1	44.1	-0.7
	42.7	41.7	42.3	42.0	41.7	42.0	41.7	41.9	-1.1
2	41.0	38.7	40.0	39.3	39.3	39.3	39.3	39.6	-0.8
	35.0	35.7	37.7	37.0	36.7	37.3	36.7	36.6	0.6
3	33.7	34.7	36.7	35.7	35.0	35.7	35.0	35.2	1.3
	33.0	34.7	36.0	35.0	35.3	35.3	35.3	34.9	1.7
4	34.3	35.0	35.3	35.0	34.7	35.3	34.7	34.9	1.3
	35.3	36.3	36.0	35.0	35.0	34.3	35.0	35.3	1.2
5	35.7	37.0	36.7	36.0	35.3	35.3	35.3	35.9	1.7
	37.7	39.0	37.7	36.7	37.0	36.3	37.0	37.3	0.5
6	37.3	39.0	37.0	37.3	37.3	38.0	37.3	37.6	1.0
	37.0	39.0	38.3	37.3	38.0	38.0	38.0	38.0	0.4
7	37.3	38.3	38.7	38.0	37.0	38.0	37.0	37.8	0.5
	36.7	37.0	38.7	38.0	36.3	37.7	36.3	37.2	1.1
8	36.7	37.0	37.3	37.0	37.0	38.7	37.0	37.2	0.4
	35.7	36.3	37.0	36.0	36.0	37.3	36.0	36.3	0.6
9	35.0	35.7	36.7	35.7	36.3	37.0	35.7	36.0	0.5
	33.7	34.7	33.0	34.7	34.7	36.3	34.7	34.5	1.0
10	33.0	34.0	31.7	33.3	33.0	35.0	33.0	33.3	2.0
	33.7	34.3	31.3	32.7	32.7	34.0	32.7	33.1	3.0
11	33.0	34.0	31.7	32.3	32.7	33.0	32.7	32.8	3.7
	32.7	33.3	32.0	32.7	32.7	31.7	32.7	32.5	4.1
12	32.7	32.0	31.7	32.3	32.7	32.0	32.7	32.3	3.7
	32.7	31.7	31.3	31.7	32.7	32.0	32.7	32.1	4.9
13	32.7	31.7	31.0	31.0	32.7	32.0	32.7	31.9	5.0
	32.0	32.0	31.0	31.0	32.7	31.7	32.7	32.1	4.7
14	32.7	32.3	31.0	31.0	33.0	31.7	33.0	32.2	4.5
	33.0	32.3	31.3	31.0	33.0	31.7	33.0	32.3	5.0
15	32.7	32.2	31.0	31.3	33.0	33.0	33.0	32.3	5.1
	33.0	32.2	31.0	31.3	33.0	32.7	33.0	32.3	5.8
16	33.0	32.7	31.3	31.3	33.7	32.7	33.7	32.6	4.9
	33.3	32.7	31.7	31.3	34.0	32.7	34.0	32.8	5.2
17	33.7	32.7	31.7	31.3	34.0	33.3	34.0	33.0	4.9
	33.7	22.0	31.7	32.0	34.0	33.0	34.0	33.1	4.9
18	33.7	22.7	32.0	32.0	34.7	33.3	34.7	33.4	4.8
	34.0	23.0	32.7	32.7	34.7	34.3	34.7	33.9	4.2
19	35.3	23.2	32.7	33.3	35.0	34.3	35.0	34.3	4.0
	34.3	24.0	32.2	34.0	35.3	34.3	35.3	34.4	3.6
20	35.0	23.7	34.3	35.0	36.0	35.3	36.0	35.2	2.1
	36.0	24.7	35.0	36.0	36.3	36.0	36.3	35.9	0.7
21	35.7	26.7	36.0	37.0	37.0	37.0	37.0	36.6	0.3
	37.0	37.3	37.0	37.3	37.0	38.0	37.7	37.4	0.1
22	--	38.0	38.0	38.3	38.3	39.0	38.3	38.3	0.3

(Continued)

* Ranges are 500 ft apart.

Table 2 (Concluded)

Range	Survey Depth, ft, at Indicated Date of Survey 25 Aug 59	3 Jan 61	29 Jan 62	2 Apr 63	3 Sep 64	3 Sep 65	7 Sep 66	Mean	Average Infill, ft
				Postdredge					
0	37.7	37.3	36.7	38.0	38.7	40.3	38.7	38.2	-1.2
	45.0	43.3	44.7	45.3	44.0	46.3	44.0	44.7	-0.8
1	41.3	42.0	43.0	43.0	45.0	44.7	45.0	43.4	-0.7
	40.7	40.3	39.7	39.3	42.3	41.0	42.3	40.8	-1.1
2	37.3	38.7	38.7	36.3	40.3	39.7	40.3	38.8	-0.8
	36.0	37.7	38.0	37.7	37.0	37.3	37.0	37.2	0.6
3	35.0	35.7	37.0	37.3	37.7	36.0	37.7	36.6	1.3
	36.3	36.3	36.3	37.7	36.7	36.0	36.7	36.6	1.7
4	36.3	36.3	35.3	37.0	36.3	35.7	36.3	36.2	1.3
	37.0	36.3	37.3	37.3	36.3	35.3	36.3	36.5	1.2
5	38.7	38.0	37.7	36.7	38.0	36.0	38.0	37.6	1.7
	39.3	38.3	37.0	37.0	38.3	36.3	38.3	37.8	0.5
6	39.7	38.3	39.7	38.3	39.3	37.3	39.3	38.6	1.0
	39.3	38.3	38.7	37.0	38.7	38.3	38.7	38.4	0.4
7	39.7	38.0	39.3	37.3	38.0	37.7	38.0	38.3	0.5
	39.7	37.0	39.3	38.3	38.3	37.3	38.3	38.3	1.1
8	37.7	37.0	38.3	37.0	37.0	39.0	37.0	37.6	0.4
	37.7	36.3	39.0	36.3	36.3	38.0	36.7	37.2	0.6
9	36.7	35.3	38.0	35.7	36.3	37.7	35.7	36.5	0.5
	36.0	34.7	36.3	35.0	34.7	37.3	34.7	35.5	1.0
10	36.7	35.3	36.0	33.7	34.7	36.3	34.7	35.3	2.0
	38.0	36.3	37.0	35.0	34.7	37.0	34.7	36.1	3.0
11	37.3	35.7	36.3	37.0	36.3	36.3	36.3	36.5	3.7
	36.3	34.7	36.3	37.3	37.3	36.7	37.3	36.6	4.1
12	36.7	34.0	36.3	37.0	36.0	36.3	36.0	36.0	3.7
	36.7	36.0	36.7	37.7	38.0	35.7	38.0	37.0	4.9
13	37.3	36.0	37.0	37.3	37.7	36.3	37.7	37.0	5.0
	36.3	35.7	36.3	37.3	37.0	36.7	37.0	36.6	4.7
14	36.7	35.3	37.0	37.7	37.0	35.7	37.0	36.6	4.5
	37.3	36.0	37.7	38.0	37.3	36.7	37.3	37.2	5.0
15	37.3	36.7	38.0	38.3	37.3	37.0	37.3	37.4	5.1
	37.7	37.3	37.7	38.7	38.7	37.7	38.7	38.1	5.8
16	38.0	36.0	38.0	38.7	37.0	37.7	37.0	37.5	4.9
	38.7	37.7	37.0	38.3	38.3	37.7	38.3	38.0	5.2
17	38.3	37.0	37.7	38.3	38.0	38.3	38.0	37.9	4.9
	38.3	37.0	38.3	37.7	38.0	38.7	38.0	38.0	4.9
18	39.3	37.3	38.3	37.7	38.0	38.7	39.0	38.2	4.8
	38.3	37.3	38.3	37.7	38.3	38.7	38.3	38.1	4.2
19	39.0	37.7	39.3	37.7	38.3	38.0	38.3	38.3	4.0
	39.0	36.7	38.3	37.3	39.0	36.7	39.0	38.0	3.6
20	38.3	36.0	37.3	37.0	38.3	35.7	38.3	37.3	2.1
	38.3	35.0	37.0	37.0	36.7	35.7	36.7	36.6	0.7
21	--	35.0	37.0	38.0	37.3	37.0	37.3	36.9	0.3
	--	36.0	37.7	--	38.0	37.7	38.0	37.5	0.1
22	--	36.7	38.7	--	39.3	39.0	39.3	38.6	0.3

Table 3

Wilmington Harbor Entrance Channel, 40-ft Project

Predredge and Postdredge Survey Depths

Northwest Half of Channel

Range*	Survey Depth, ft, at Indicated Date of Survey: 6 Dec 71	20 Nov 72	19 Dec 74	12 Dec 75	16 Oct 76	20 Dec 79	11 Dec 80	6 Dec 81	28 Oct 82	Mean	Average Infill, ft
Predredge											
0	40.0	42.3	43.0	44.7	47.3	50.7	47.0	49.7	48.3	45.9	-0.7
	44.7	47.0	44.7	50.7	48.3	51.7	52.7	52.7	53.0	49.4	-1.0
1	45.3	49.7	50.7	51.0	52.0	53.0	53.0	51.0	53.3	51.0	-1.1
	45.0	45.0	44.3	47.0	46.0	47.3	46.7	47.0	47.3	46.2	-0.3
2	42.3	43.0	43.7	43.0	44.7	45.0	45.7	45.0	45.0	44.2	-0.2
	41.0	43.7	42.7	44.3	44.0	44.7	43.7	42.7	43.0	43.3	-0.2
3	41.0	43.3	44.0	44.3	44.0	42.3	43.0	42.0	42.0	42.9	0.4
	39.7	42.3	42.0	42.7	43.7	41.3	42.0	41.0	40.7	41.7	0.2
4	39.7	41.0	41.7	42.3	42.3	42.0	42.7	42.0	40.0	41.5	0.5
	39.3	40.3	42.3	42.0	43.0	41.0	44.7	43.0	42.7	42.1	0.2
5	39.3	41.3	40.3	42.7	44.7	41.3	43.0	43.0	42.3	42.0	0.1
	40.3	40.7	40.3	41.3	43.3	42.0	43.7	42.7	41.3	41.7	1.3
6	41.7	39.3	41.3	43.3	43.7	43.0	43.3	43.3	41.7	42.3	1.0
	40.3	41.3	43.3	43.7	45.3	39.7	43.3	42.7	41.7	42.4	0.8
7	39.7	39.7	39.7	42.0	43.7	40.3	43.0	42.0	41.0	41.2	1.3
	38.3	41.0	39.3	39.3	44.0	38.7	41.7	41.3	42.0	40.6	0.8
8	38.3	41.7	38.7	38.0	41.7	38.3	40.0	41.0	42.0	40.0	0.9
	38.3	39.3	38.0	37.7	38.7	38.0	40.7	41.3	42.0	39.3	1.0
9	39.7	39.3	37.3	37.3	38.0	36.7	39.3	39.3	41.0	38.7	0.8
	39.7	39.3	37.0	38.0	37.3	36.0	39.3	39.3	40.3	38.5	1.4
10	39.3	40.3	39.3	38.7	38.7	38.3	39.7	39.0	39.7	39.2	1.4
	39.0	40.7	39.0	39.7	38.3	39.3	41.3	41.3	40.0	39.8	1.8
11	40.3	40.7	38.7	39.3	39.0	39.0	42.7	40.7	40.7	40.1	1.3
	39.0	39.3	38.3	38.7	38.7	39.0	42.0	40.7	41.0	39.6	1.7
12	38.3	37.7	37.7	37.7	38.7	38.7	42.0	40.7	40.7	39.1	1.6
	38.7	38.7	37.3	37.3	37.7	38.3	41.7	40.0	40.3	38.9	1.9
13	37.7	38.0	36.3	37.3	37.7	37.7	40.7	39.0	39.7	38.2	2.8
	37.7	37.0	35.7	36.7	36.7	36.7	39.7	38.3	39.0	37.5	2.5
14	36.7	36.3	35.3	35.7	36.3	36.0	38.7	38.0	38.3	36.8	2.6
	36.7	35.7	35.7	35.3	35.7	36.0	38.7	38.0	37.7	36.6	2.7
15	36.3	35.3	35.3	35.3	36.0	35.7	37.3	37.3	37.3	36.2	2.9
	36.7	35.3	35.0	35.3	36.0	35.3	37.3	37.0	37.0	36.1	3.1
16	37.3	35.7	35.3	35.7	35.3	35.3	37.0	37.0	37.0	36.2	2.9
	37.7	34.7	35.7	35.3	35.7	35.7	37.3	37.3	37.3	36.3	3.0
17	37.7	35.7	35.3	36.0	35.7	36.0	37.3	37.0	37.0	36.4	3.1
	38.0	35.7	35.7	35.7	36.3	36.7	37.3	37.3	37.7	36.7	2.8
18	38.7	37.0	36.3	36.0	36.7	36.7	37.7	37.7	37.7	37.2	2.5
	39.3	36.3	36.7	37.0	37.0	36.7	38.0	37.7	38.3	37.4	2.5
19	39.3	37.0	37.7	37.7	38.0	37.3	38.7	38.3	39.0	38.1	1.7
	39.7	37.7	38.0	37.7	38.0	38.0	39.7	38.7	39.3	38.5	1.5
20	39.7	38.7	38.3	38.7	39.0	39.0	40.0	39.0	39.7	39.1	0.9
	39.0	39.0	39.0	39.0	39.0	39.0	40.0	40.3	40.3	39.5	0.3
21	38.3	39.0	39.0	39.0	40.0	39.7	40.3	40.3	40.7	39.6	-0.1
	39.7	39.7	39.7	40.0	39.7	40.7	40.7	40.0	41.0	40.1	-0.1
22	39.7	40.3	41.0	41.0	41.0	41.0	42.0	41.0	41.0	40.9	-0.3
	--	40.3	40.3	41.0	41.7	42.0	42.0	42.0	42.0	41.4	-0.7
23	--	40.7	40.7	41.0	41.0	42.0	42.0	42.0	42.0	41.4	-0.6
	--	40.7	40.7	41.0	41.0	41.7	42.0	--	42.0	41.4	-0.3
24	--	41.3	40.7	42.0	41.7	42.0	42.3	--	42.3	41.8	-0.6
	--	--	40.7	41.0	41.3	--	42.3	--	42.3	41.5	-0.6
25	--	--	40.0	41.0	41.0	--	41.3	--	42.0	41.1	-0.5
	--	--	40.0	41.0	49.7	--	47.0	--	42.0	41.1	-0.7
26	--	--	40.0	40.7	40.7	--	42.0	--	41.3	40.9	-0.6
	--	--	41.0	41.3	--	--	42.7	--	42.7	41.9	-0.7
27	--	--	40.7	41.3	--	--	42.7	--	43.0	41.9	-0.6
	--	--	40.0	41.3	--	--	42.0	--	41.7	41.3	-0.4
28	--	--	38.0	39.0	--	--	39.7	--	40.3	39.3	-0.7
	--	--	37.7	38.7	--	--	39.7	--	40.0	39.0	-0.4
29	--	--	39.0	40.7	--	--	41.7	--	42.0	40.9	-0.8
	--	--	--	--	--	--	42.7	--	42.3	42.5	-0.8
30	--	--	--	--	--	--	42.3	--	42.0	42.2	-0.5

(Continued)

* Ranges are 500 ft apart.

Table 3 (Concluded)

Range	2 Jul 71	18 Jan 72	4 Jan 74	5 Mar 75	30 Jan 76	24 Oct 78	19 Mar 80	11 Mar 81	6 Jan 82	Mean	Average Infill, ft
	Survey Depth, ft, at Indicated Date of Survey										
					Postdredge						
0	36.7	41.3	41.0	42.7	45.7	51.7	49.3	48.3	50.0	45.2	-0.7
	43.0	43.7	45.3	46.3	46.7	53.0	53.0	52.3	52.7	48.5	-1.0
1	41.3	49.3	49.3	51.0	51.0	54.0	53.7	48.0	51.3	49.9	-1.1
	45.3	44.7	45.0	46.0	45.3	46.3	46.7	47.3	46.3	45.9	-0.3
2	43.0	42.7	43.3	44.3	43.3	44.7	44.7	44.3	44.7	44.0	-0.2
	42.3	42.7	43.7	43.3	44.0	43.0	44.3	42.7	42.3	43.1	-0.2
3	42.3	43.7	44.7	44.3	43.0	43.0	43.3	42.7	42.0	43.3	0.4
	41.3	41.7	42.0	42.7	43.0	41.7	43.0	40.7	41.3	41.9	0.2
4	41.0	42.0	41.7	42.3	42.0	41.0	43.3	42.7	42.0	42.0	0.5
	41.3	42.0	42.3	43.0	41.7	41.3	43.7	43.0	42.7	42.3	0.2
5	41.0	41.0	42.0	42.3	42.3	42.3	42.3	43.0	42.3	42.1	0.1
	42.1	42.1	43.7	43.3	44.0	41.7	44.7	43.3	42.0	43.0	1.3
6	43.7	43.0	44.7	42.3	43.3	42.7	44.7	43.0	42.3	43.3	1.0
	43.7	41.7	44.0	42.3	44.7	43.3	44.3	42.3	42.3	43.2	0.8
7	42.7	43.0	42.8	40.7	43.3	43.0	43.3	42.0	42.0	42.5	1.3
	41.3	41.7	41.0	40.3	41.3	41.0	42.7	41.3	42.0	41.4	0.8
8	41.0	40.0	40.7	39.7	40.0	41.0	42.7	40.3	43.0	40.9	0.9
	41.3	40.7	39.0	38.0	39.3	40.0	41.0	40.7	42.3	40.3	1.0
9	42.0	40.7	38.7	37.7	37.7	38.7	40.0	39.0	41.3	39.5	0.8
	42.3	43.0	39.7	38.3	38.7	38.3	39.0	38.3	40.7	39.9	1.4
10	43.0	42.0	40.3	38.7	39.7	39.7	40.7	39.7	41.3	40.6	1.4
	44.3	41.0	41.7	40.7	41.0	41.0	43.3	40.7	40.3	41.6	1.8
11	42.7	42.0	42.0	39.3	40.3	41.0	42.3	41.7	41.0	41.4	1.2
	42.3	41.3	41.0	38.3	39.3	43.0	44.0	41.3	41.3	41.3	1.7
12	42.0	39.3	41.0	35.7	40.0	41.3	43.0	41.7	42.3	40.7	1.6
	42.7	40.0	40.7	37.7	40.7	41.0	42.3	41.0	41.0	40.8	1.9
13	43.0	40.7	40.7	38.0	39.3	41.0	41.7	40.7	42.7	41.0	2.8
	41.3	40.7	40.3	37.0	38.7	40.2	40.7	40.0	41.3	40.0	2.5
14	40.3	40.0	40.0	37.0	38.0	39.0	39.7	40.3	40.7	39.4	2.6
	39.3	39.7	40.0	36.3	38.3	39.0	40.0	39.7	41.3	39.3	2.7
15	39.7	39.0	39.7	37.3	37.3	39.3	39.3	40.3	30.0	39.1	2.9
	39.7	39.0	40.0	36.0	38.7	39.3	39.7	40.0	40.0	39.2	3.1
16	40.7	39.0	38.7	37.0	37.7	38.7	40.0	40.0	40.0	39.1	2.9
	40.7	39.3	39.0	37.0	39.3	38.7	39.7	39.7	40.3	39.3	3.0
17	40.7	39.7	39.3	37.3	39.7	39.3	40.0	39.3	40.3	39.5	3.1
	40.7	39.3	39.3	38.0	38.7	39.0	40.3	39.3	40.7	39.5	2.8
18	40.7	39.0	39.3	37.3	39.7	40.3	41.0	39.7	49.7	39.7	2.5
	40.0	39.7	39.3	38.3	40.0	40.7	40.7	39.7	40.7	39.9	2.5
19	39.7	39.7	40.3	38.7	39.0	40.7	40.3	39.7	40.7	39.9	1.7
	40.0	39.7	39.7	39.3	39.7	40.7	40.7	39.7	40.3	40.0	1.5
20	39.7	39.7	39.3	39.3	40.0	40.7	40.7	39.7	41.0	40.0	0.9
	39.7	39.0	39.3	39.3	39.3	40.3	40.7	40.0	40.7	39.8	0.3
21	40.3	39.0	39.0	39.0	39.0	40.0	39.7	39.7	40.0	39.5	-0.1
	40.3	39.3	40.0	39.3	39.3	41.0	40.7	40.0	40.3	40.0	-0.1
22	40.3	40.0	40.7	41.3	39.7	--	41.3	40.7	41.0	40.6	-0.3
	40.3	40.3	41.0	41.0	39.3	--	41.3	41.0	41.3	40.7	-0.7
23	40.3	40.7	40.3	40.7	40.0	--	41.3	41.0	42.0	40.8	-0.6
	41.0	40.0	40.7	41.0	40.3	--	41.7	41.7	42.0	41.1	-0.3
24	41.0	41.0	40.7	41.0	41.0	--	42.0	42.0	--	41.2	-0.6
	--	40.3	40.3	41.0	40.0	--	42.0	42.0	--	40.9	-0.6
25	--	40.0	40.0	40.7	40.0	--	41.3	41.3	--	40.6	-0.5
	--	40.0	39.7	--	40.0	--	41.3	41.0	--	40.4	-0.7
26	--	39.7	39.7	--	40.0	--	41.0	41.0	--	40.3	-0.6
	--	40.7	40.3	--	40.7	--	42.3	42.0	--	41.2	-0.7
27	--	41.0	41.0	--	40.3	--	42.3	42.0	--	41.3	-0.6
	--	--	40.7	--	40.7	--	41.3	40.7	--	40.9	-0.4
28	--	--	38.0	--	38.0	--	--	39.7	--	38.6	-0.7
	--	--	37.7	--	38.3	--	--	39.7	--	38.6	-0.4
29	--	--	39.3	--	39.7	--	--	41.7	--	40.1	-0.8
	--	--	--	--	--	--	--	41.7	--	41.7	-0.8
30	--	--	--	--	--	--	--	41.7	--	41.7	-0.5

Table 4

Wilmington Harbor Entrance Channel, 40-ft Project

Predredge and Postdredge Survey Depths

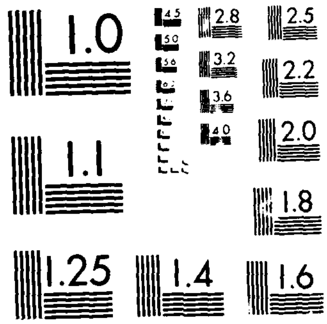
Southeast Half of Channel

Range*	6 Dec 71	20 Nov 72	19 Dec 74	12 Dec 75	16 Oct 76	20 Dec 79	11 Dec 80	6 Dec 81	28 Oct 82	Mean	Average Infill, ft
	Survey Depth, ft, at Indicated Date of Survey										
					Predredge						
0	44.1	47.0	47.0	48.7	46.3	49.3	53.7	47.7	51.3	48.3	0.1
	45.7	48.0	49.0	49.0	47.3	47.0	49.3	49.3	50.0	48.3	0.0
1	39.3	43.0	43.3	43.0	44.0	45.0	44.7	44.1	43.7	43.3	0.7
	40.3	40.[illegible]	39.3	41.3	41.0	42.0	42.7	43.3	42.7	41.4	0.8
2	40.0	40.0	41.0	42.7	44.3	43.3	43.0	43.7	43.3	42.2	0.2
	39.0	42.7	42.0	45.0	44.3	44.7	43.7	44.3	43.0	43.2	0.1
3	38.7	40.3	41.7	42.7	42.7	42.7	43.7	43.7	42.3	42.1	0.3
	38.7	40.3	40.0	40.7	42.0	42.0	41.3	42.0	41.7	41.0	0.4
4	38.7	39.3	40.3	40.7	41.7	41.7	41.7	41.0	40.7	40.6	0.9
	38.7	40.0	40.0	40.7	42.0	40.7	42.3	40.7	40.7	40.6	0.6
5	39.3	40.3	41.0	41.0	42.7	41.0	41.7	40.7	41.0	41.0	0.9
	41.0	41.3	41.7	43.0	44.7	42.7	43.0	42.0	41.0	42.3	0.7
6	42.0	44.0	43.3	43.0	44.3	43.7	44.0	42.3	41.3	43.1	1.0
	41.0	42.7	42.7	43.0	44.0	43.0	45.0	43.3	42.3	43.0	1.0
7	40.0	42.0	41.3	43.0	44.7	43.7	44.0	43.0	42.3	42.7	0.7
	40.7	45.0	40.0	42.3	44.0	43.0	42.3	42.3	42.3	42.4	0.5
8	40.7	44.7	40.7	40.7	43.3	42.7	43.0	41.7	42.3	42.2	0.1
	40.3	39.7	38.0	40.0	41.0	41.3	42.0	40.7	43.3	40.7	1.0
9	40.7	41.3	38.0	39.0	40.0	40.0	41.0	40.0	42.7	40.3	0.9
	40.7	41.3	38.0	38.7	39.3	39.3	40.0	39.0	42.7	39.9	0.6
10	41.7	40.7	37.0	38.0	39.0	39.3	40.0	39.0	41.0	39.5	1.1
	41.0	40.7	37.3	38.3	38.3	39.7	40.7	39.7	40.7	39.6	1.4
11	40.3	39.7	37.0	37.7	38.3	39.3	41.3	39.3	41.3	39.4	1.5
	39.7	39.0	36.0	36.7	37.3	39.0	40.7	39.7	40.0	38.7	2.0
12	39.3	39.7	36.7	36.3	37.0	39.0	41.7	38.3	40.0	48.7	2.1
	39.0	37.7	36.0	36.3	36.7	38.0	41.0	39.0	39.7	38.2	2.5
13	37.3	37.0	35.7	36.0	36.7	38.0	40.0	37.7	39.0	37.5	3.3
	37.3	36.3	35.0	35.0	36.3	36.0	39.0	37.3	38.0	36.8	2.9
14	36.7	36.0	34.7	36.7	35.7	36.3	37.3	37.3	37.3	36.4	3.1
	35.7	34.7	33.3	34.0	36.0	35.7	36.3	36.3	36.7	35.4	4.0
15	36.0	35.0	34.0	34.0	35.7	35.3	36.3	36.7	36.7	35.5	3.7
	36.7	34.7	33.7	34.0	35.3	35.0	36.0	36.3	36.0	35.3	3.5
16	37.7	34.7	34.0	33.7	33.0	36.0	35.7	36.0	36.7	35.3	3.7
	38.0	34.3	34.7	33.3	34.7	35.0	36.0	36.3	37.0	35.5	3.4
17	37.7	35.3	34.0	33.7	35.0	36.0	36.0	36.3	36.7	35.6	3.4
	38.0	35.3	34.7	34.3	35.7	37.3	36.3	36.0	37.3	36.1	3.4
18	39.7	36.0	35.0	34.7	35.7	38.0	37.0	36.7	37.7	36.7	2.9
	40.7	35.7	35.7	35.0	36.3	37.3	37.3	36.7	38.0	37.0	2.6
19	40.0	36.7	36.7	36.3	37.7	37.7	38.0	36.7	38.0	37.5	2.2
	40.7	37.7	37.3	37.3	37.7	37.7	38.0	38.0	38.7	38.1	1.1
20	41.0	37.7	37.7	37.7	38.0	38.7	38.7	38.3	38.[illegible]	38.5	0.4
	40.0	38.7	38.7	38.7	39.0	39.3	39.3	39.3	39.3	39.1	0.4
21	40.0	38.7	39.0	39.0	39.0	39.3	40.0	39.7	40.0	39.4	0.0
	40.3	39.3	39.3	39.7	40.0	40.3	40.3	40.3	40.3	40.0	0.[illegible]
22	41.0	40.3	40.3	41.0	40.7	41.0	41.7	40.7	41.0	40.9	-0.4
	--	42.0	40.7	41.7	41.3	41.0	42.0	41.3	41.7	41.3	-0.5
23	--	42.7	40.3	40.7	40.7	41.7	41.7	42.0	41.7	41.2	-0.4
	--	42.0	41.0	41.7	42.7	41.7	42.3	--	42.7	42.0	-0.6
24	--	--	41.0	42.0	41.3	42.0	41.0	--	42.0	41.6	-0.[illegible]
	--	--	40.7	41.7	41.0	--	42.0	--	42.0	41.6	-0.[illegible]
25	--	--	40.0	41.0	41.0	--	42.0	--	42.0	41.[illegible]	-0.5
	--	--	40.0	40.3	41.0	--	41.3	--	41.0	40.[illegible]	-0.5
26	--	--	40.0	41.0	41.0	--	41.[illegible]	--	42.0	41.[illegible]	-0.7
	--	--	41.0	42.0	--	--	42.[illegible]	--	42.3	42.0	-0.9
27	--	--	41.0	42.0	--	--	42.3	--	42.[illegible]	[illegible]	-0.[illegible]
	--	--	40.7	42.0	--	--	42.7	--	43.0	[illegible]	-0.9
28	--	--	39.[illegible]	40.7	--	--	41.[illegible]	--	41.0	[illegible]	-0.[illegible]
	--	--	39.3	40.0	--	--	41.[illegible]	--	41.3	[illegible]	[illegible]
29	--	--	40.[illegible]	41.[illegible]	--	--	42.3	--	42.0	[illegible]	[illegible]
	--	--	--	--	--	--	42.[illegible]	--	[illegible]	[illegible]	[illegible]
30	--	--	--	--	--		[illegible]	--	[illegible]	[illegible]	[illegible]

(Continued)

* Ranges are 500 ft apart.

AD-A198 890 IMPROVEMENT OF OPERATIONS AND MAINTENANCE TECHNIQUES 2/2
RESEARCH PROGRAM ADV..(U) ARMY ENGINEER WATERWAYS
EXPERIMENT STATION VICKSBURG MS HYDRA..
UNCLASSIFIED M J TRAWLE ET AL. JUL 88 WES/TR/HL-88-16 F/G 13/2 NL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2.8
3.2
3.6
4.0
4.5
5.0
5.6

Table 4 (Concluded)

Range	Survey Depth, ft, at Indicated Date of Survey: 2 Jul 71	18 Jan 72	4 Jan 74	5 Mar 75	30 Jan 76	24 Oct 78	19 Mar 80	11 Mar 81	6 Jan 82	Mean	Average Infill, ft
					Postdredge						
0	41.1	44.3	46.0	51.0	48.7	48.3	49.3	53.3	51.0	48.4	0.1
	47.7	47.0	47.7	50.0	49.7	48.7	48.0	48.7	57.3	48.3	0.0
1	45.7	43.0	43.0	43.3	43.0	45.0	45.0	43.3	44.3	44.0	0.7
	43.7	42.7	40.0	40.7	42.0	43.3	42.0	42.3	42.7	42.2	0.8
2	41.7	41.7	41.3	43.7	42.3	43.3	43.0	42.7	4[illegible].3	42.4	0.2
	41.7	43.0	43.7	44.3	43.0	44.3	44.0	43.3	4[illegible].0	43.3	0.1
3	40.7	41.7	44.0	43.0	42.3	42.3	42.7	43.3	41.7	42.4	0.3
	41.0	42.0	40.7	41.0	41.7	42.0	42.0	41.7	40.7	41.4	0.4
4	41.7	41.3	41.0	42.0	41.7	41.7	41.7	41.7	40.7	41.5	0.9
	41.7	40.0	41.0	41.7	41.7	41.0	41.3	41.7	40.7	41.2	0.6
5	42.0	41.3	42.3	43.0	42.7	42.0	41.3	41.3	41.0	41.9	0.9
	42.7	43.0	43.3	44.3	44.0	43.0	43.0	42.3	41.0	43.0	0.7
6	44.3	43.3	44.0	44.0	45.0	45.0	44.3	44.0	42.7	44.1	1.0
	44.3	42.3	44.3	43.7	43.7	43.7	45.0	44.3	42.7	44.0	1.0
7	43.7	42.0	42.0	43.0	43.7	45.0	44.7	44.0	42.3	43.4	0.7
	42.3	42.7	41.3	42.3	44.7	44.0	43.3	43.0	42.7	42.9	0.5
8	42.0	41.0	42.0	41.7	43.3	41.3	43.0	42.0	44.7	42.3	0.1
	42.3	42.0	39.7	40.0	40.7	43.0	42.0	42.0	44.0	41.7	1.0
9	42.3	42.0	40.3	40.0	40.3	41.3	41.7	40.7	42.3	41.2	0.9
	42.0	42.0	40.0	39.3	38.3	41.0	40.7	40.0	41.3	40.5	0.6
10	41.7	41.7	40.7	38.7	38.0	41.3	41.7	39.7	41.7	40.6	1.1
	42.0	41.0	41.0	40.0	39.3	41.0	42.3	41.0	41.3	41.0	1.4
11	43.7	39.7	40.3	39.7	37.7	42.0	43.3	40.7	41.3	40.9	1.5
	43.0	40.3	39.7	39.0	38.0	42.3	42.7	41.0	40.7	40.7	2.0
12	43.0	39.7	40.3	38.3	38.3	42.0	43.0	40.7	41.7	40.8	2.1
	43.3	40.3	39.7	38.3	38.0	42.3	42.0	41.0	41.3	40.7	2.5
13	42.7	41.3	40.7	39.0	39.0	41.3	41.3	40.7	41.3	40.8	3.3
	41.0	39.7	40.0	37.7	37.3	40.7	40.7	39.7	40.3	39.7	2.9
14	40.3	40.3	39.3	37.7	38.3	40.7	40.0	40.3	39.0	39.5	3.1
	40.0	41.0	39.3	38.0	36.7	40.7	40.0	40.0	39.0	3[illegible].4	4.0
15	39.7	39.7	39.0	38.0	37.3	40.3	40.0	40.0	39.0	39.2	3.7
	40.0	39.3	39.0	38.3	35.7	40.0	39.3	39.7	38.3	38.8	3.5
16	40.0	39.3	39.0	38.0	37.7	39.7	39.3	39.7	38.0	39.0	3.7
	40.0	38.7	39.0	36.7	38.0	39.3	39.7	39.0	40.0	38.9	3.4
17	40.0	38.7	38.3	36.7	38.0	39.7	39.7	39.7	40.0	39.0	3.4
	40.3	39.3	39.0	37.0	38.7	40.0	40.7	40.0	40.3	39.5	3.4
18	40.0	39.3	39.0	38.0	39.3	40.0	40.3	40.3	40.3	39.6	2.9
	40.3	38.7	39.0	38.0	38.7	40.7	40.7	40.0	40.0	39.6	2.6
19	39.7	39.0	39.7	38.3	39.0	41.0	40.3	30.7	39.3	39.7	2.2
	39.3	38.7	38.7	39.3	38.0	40.3	39.0	39.7	39.7	39.2	1.1
20	39.7	38.3	38.0	38.7	37.7	39.7	38.7	39.7	39.7	38.9	0.4
	39.3	39.0	39.0	39.3	38.3	40.0	40.3	40.0	40.0	39.5	0.4
21	40.3	38.0	38.0	30.3	38.7	40.0	40.0	40.0	40.0	39.4	0.0
	41.3	38.7	39.0	40.0	39.0	41.0	41.0	40.0	40.0	40.0	0.0
22	41.3	40.7	40.3	40.0	39.7	--	41.3	40.3	40.0	40.5	-0.4
	41.0	40.7	40.0	41.0	39.7	--	41.7	41.0	41.0	40.8	-0.5
23	41.0	40.3	40.7	40.7	39.7	--	41.3	41.3	41.7	40.8	-0.4
	42.0	40.7	40.7	41.7	40.7	--	42.0	42.0	42.0	41.4	-0.6
24	--	41.0	41.3	41.3	40.3	--	42.0	42.0	--	41.4	-0.2
	--	41.0	41.0	41.0	41.0	--	41.7	42.0	--	41.3	-0.3
25	--	40.3	40.0	41.0	40.0	--	41.3	41.3	--	40.7	-0.5
	--	40.0	39.7	--	39.7	--	40.7	41.0	--	40.2	-0.5
26	--	40.0	40.0	--	40.0	--	41.3	41.3	--	40.5	-0.6
	--	40.7	40.7	--	40.7	--	41.7	42.0	--	41.2	-0.8
27	--	41.0	41.7	--	41.0	--	41.3	42.0	--	41.4	-0.6
	--	--	41.0	--	40.3	--	42.0	42.0	--	41.3	-0.8
28	--	--	39.7	--	39.3	--	--	41.0	--	40.0	-0.7
	--	--	40.3	--	39.3	--	--	41.0	--	40.0	-0.6
29	--	--	--	--	40.7	--	--	42.0	--	41.0	-0.7
	--	--	--	--	--	--	--	42.0	--	42.0	-0.3
30	--	--	--	--	--	--	--	42.3	--	42.3	-0.6

Table 5

Lynnhaven Inlet Infill Rates

Channel Layout*	Shoaling Period	Infill, cu yd				Average Infill Rate, cu yd/year
		West Overwidth	Channel	East Overwidth	Total	
A	1 Aug 65 to 3 May 68	14,000	84,200	7,900	106,100	38,400
B	17 Jun 68 to 30 Sep 70	14,600	28,000	5,000	47,600	20,900
C	10 Nov 70 to 3 Dec 73	8,100	13,700	100	21,900	7,100
D	30 Mar 77 to 6 Nov 79	3,200	33,500	3,300	40,000	15,400
E	10 Jun 82 to 24 Sep 84	--	39,700	--	39,700	17,000
					Average	19,760

* See Figure 13.

Table 6

Gulfport Harbor Entrance Channel, 30-ft Project

Predredge and Postdredge Survey Depths

Range 1,000 ft	Survey Depth, ft, at Indicated Date of Survey				
	16 Dec 76	30 Mar 78	21 Aug 79	16 Sep 82	Mean
	Dredging Contract Specs of 30 ft + 2 ft Allowable Dredging Tolerance				
Predredge					
0.5	31.6	32.1	28.6	26.7	29.8
2.5	26.5	28.6	29.8	24.2	27.3
4.5	27.8	27.3	30.6	24.8	27.6
6.5	27.8	27.4	30.3	24.5	27.5
8.5	28.2	28.3	31.6	24.5	28.2
10.5	29.3	26.8	28.6	25.6	27.6
12.5	30.8	26.9	31.1	27.6	29.1
14.5	29.3	27.6	30.7	25.3	28.2
16.5	27.6	28.0	30.8	26.3	28.2
18.5	28.3	27.7	30.6	26.4	28.3
20.5	28.7	28.3	31.3	26.9	28.8
22.5	29.4	28.3	34.8	26.8	29.8
24.5	29.5	28.7	32.2	26.4	29.2
26.5	29.9	28.8	29.8	27.4	29.0
28.5	30.4	29.3	32.7	28.0	30.1
30.5	29.0	30.2	33.3	28.0	30.1
32.5	29.8	30.5	--	28.5	29.6
34.5	30.2	30.7	--	28.5	29.8
36.5	30.0	30.8	--	28.3	29.7
38.5	30.4	[illegible]	--	29.3	30.6
40.5	30.1	32.3	--	30.2	31.0
Postdredge					
	22 Apr 76	22 Jun 77	8 Feb 79	13 Feb 81	
0.5	34.8	33.0	34.1	35.1	34.3
2.5	32.9	33.8	33.3	35.1	33.8
4.5	33.8	32.7	34.3	34.9	33.9
6.5	34.5	35.1	33.4	34.9	34.5
8.5	35.6	36.0	35.3	35.2	35.5
10.5	36.1	33.7	33.6	35.9	34.8
12.5	37.2	33.7	31.9	35.4	34.6
14.5	34.6	34.0	31.5	34.8	33.7
16.5	34.8	33.1	35.2	35.3	34.6
18.5	34.4	35.1	35.9	37.3	35.7
20.5	33.9	34.0	34.7	37.5	35.0
22.5	34.6	33.9	35.3	37.2	35.3
24.5	34.0	33.8	31.7	35.3	33.7
26.5	34.6	33.4	33.1	37.3	34.6
28.5	34.8	35.6	33.8	36.9	35.3
30.5	34.3	34.3	34.7	37.3	35.2
32.5	34.1	34.8	--	33.9	34.3
34.5	33.0	34.1	--	34.5	33.9
36.5	32.9	33.4	--	34.4	33.6
38.5	34.0	33.5	--	34.8	34.1
40.5	32.9	35.3	--	33.3	33.8

(Continued)

Table 6 (Concluded)

Range 1,000 ft	Survey Depth, ft, at Indicated Date of Survey: 20 Oct 75	20 Aug 80	Mean
	Dredging Contract Specs of 30 ft + 2 ft Advance Maintenance + 2 ft Allowable Dredging Tolerance		
Predredge			
0.5	26.5	28.0	27.3
2.5	24.1	30.4	27.3
4.5	22.8	29.5	26.2
6.5	23.6	29.6	26.6
8.5	14.6	31.6	28.1
10.5	25.5	30.2	27.9
12.5	26.1	29.1	27.6
14.5	26.1	28.1	27.1
16.5	26.1	27.9	27.0
18.5	26.6	27.8	27.2
20.5	25.8	29.2	27.5
22.5	26.6	29.0	27.8
24.5	26.6	29.4	28.0
26.5	27.2	29.8	28.5
28.5	26.9	28.8	27.8
30.5	27.[illegible]	27.6	27.7
32.5	28.3	28.7	28.5
34.5	28.6	29.3	29.0
36.5	29.5	29.3	29.4
38.5	30.5	29.3	29.9
40.5	30.9	30.0	30.5
Postdredge	15 Oct 74	19 Feb 80	
0.5	33.5	32.8	33.2
2.5	33.9	34.0	34.0
4.5	33.0	33.1	33.1
6.5	33.0	33.5	33.3
8.5	33.6	34.3	34.0
10.5	33.3	35.3	34.3
12.5	32.8	33.6	33.2
14.5	33.6	33.9	33.8
16.5	33.9	30.7	32.8
18.5	33.8	30.5	32.2
20.5	33.2	31.5	32.4
22.5	32.6	34.7	33.7
24.5	33.3	33.8	33.6
26.5	33.3	33.1	33.2
28.5	34.3	32.7	33.5
30.5	34.1	33.3	33.7
32.5	34.1	32.9	33.5
34.5	34.4	31.4	32.9
36.5	34.6	31.4	33.0
38.5	34.0	31.3	32.7
40.5	34.7	31.9	33.3

Table 7

Gulfport Harbor Entrance Channel, 30-ft Project

Range 1,000 ft	Survey Depth, ft, at Indicated Date of Survey: Feb 81 After Dredging	Jun 81 Condition	Feb 82 Condition	Sep 82 Before Dredging
14	33.5	32.0	34.0	31.5
16	36.0	31.0	33.0	30.0
18	36.0	31.0	32.0	29.0
20	35.0	31.0	32.0	29.5
22	34.0	31.0	32.0	29.5
24	39.0	34.5	32.5	30.0
26	38.5	35.0	32.0	30.0
27	39.0	35.0	32.0	29.0
30	36.0	35.0	32.0	29.0
32	38.5	35.0	31.0	29.5
34	39.0	34.5	33.5	31.5
36	39.0	34.5	34.5	30.0
38	36.5	36.0	35.0	30.0
40	36.0	35.0	33.5	30.5
42	37.0	35.5	35.5	33.5
44	37.0	35.5	34.0	31.5
46	36.5	34.5	33.5	30.5
48	36.0	34.5	33.0	30.5
50	36.0	33.0	31.5	30.0
52	36.0	33.0	31.5	27.0
54	36.0	33.0	30.0	27.5
Overall average	36.7	33.8	32.8	30.0

Table 8

Galveston Entrance Channel (Outer Bar) Shoaling Rates

38-ft Project Depth

Shoaling Period Dates	Advance Maintenance ft	Dredging Tolerance ft	Annual Shoaling Volume, 100 cu yd: Range 7+000 to 13+000	Range 13+000 to 19+000	Range 19+000 to 25+000	Total
24 Sep 58 to 16 July 59	0	2	473	317	254	1,044
29 Dec 59 to 17 July 60	0	2	495	398	250	1,143
01 Oct 60 to 17 July 61	0	2	256	345	409	1,010
Average			408	353	304	1,065
24 Oct 61 to 18 July 62	2	2	761	504	392	1,657
17 Sep 62 to 15 May 63	2	2	128	222	304	654
26 Aug 63 to 26 May 64	2	2	210	300	No data	--
Average			366	342	348	1,056

Table 9

Coos Bay Entrance Channel, 40-ft Project

North Flare

Range 1,000 ft	Survey Depth, ft, at Indicated Date of Survey: Predredge 1 Apr 70	7 Apr 71	15 Aug 72	20 May 74	29 Apr 76	Mean	Postdredge 16 Aug 69	28 Aug 70	12 Jul 71	27 Sep 73	19 Jun 75	Mean	Average Infill, ft
-20	47.0	47.0	47.0	47.0	47.0	47.0	48.3	47.7	48.7	47.3	48.3	48.1	1.1
-17.5	46.0	45.3	45.0	45.3	45.0	45.3	47.3	46.0	47.3	46.3	47.7	46.9	1.6
-15	45.0	44.0	43.7	44.0	44.0	44.1	46.3	46.0	45.3	45.0	46.3	45.8	1.7
-12.5	43.0	43.7	42.0	44.0	43.0	43.1	47.0	45.7	44.7	44.5	45.0	45.4	2.3
-10	42.3	42.3	40.7	42.0	42.0	41.9	45.0	45.0	43.3	43.5	44.7	44.3	2.4
-7.5	42.0	41.3	40.0	41.5	41.0	41.2	44.7	44.0	42.7	43.0	43.5	43.6	2.4
-5	41.3	40.7	39.0	41.5	40.0	40.5	44.3	44.0	42.7	42.5	43.5	43.4	2.9
-2.5	40.3	40.3	38.5	41.0	39.0	39.8	43.3	44.3	42.7	43.0	43.5	43.4	3.6
0	39.7	40.0	36.3	40.5	38.5	39.0	42.7	44.0	42.7	43.0	44.0	43.3	4.3
2.5	39.3	40.7	35.0	40.0	37.5	38.5	40.0	43.3	42.0	42.5	44.5	42.5	4.0
5	39.3	40.7	34.0	39.5	36.0	37.9	37.7	43.0	42.5	42.5	45.5	42.2	4.3
7.5	38.7	40.3	34.0	38.5	34.5	37.2	36.7	43.7	42.5	40.0	45.4	41.7	4.5
10	38.7	40.0	39.5	42.0	40.5	40.1	39.7	41.7	44.5	47.5	49.0	44.5	4.4
12.5	36.3	42.0	45.5	45.5	42.0	42.3	42.7	42.7	46.5	50.5	50.5	46.6	4.3
15	36.7	43.0	40.5	40.0	40.0	40.0	42.7	41.3	47.0	43.7	44.0	43.7	3.7
17.5	46.0	43.0	37.0	37.0	40.0	40.6	46.0	46.0	41.0	42.0	44.5	43.9	3.3
20	55.5	48.7	43.5	44.5	43.5	47.1	50.5	47.5	45.0	45.0	44.5	46.5	-0.6
22.5	39.0	42.0	40.0	43.0	38.0	40.4	37.7	37.0	42.5	42.0	42.0	40.2	-0.2
25	36.5	35.5	36.5	34.5	34.0	35.4	36.7	36.0	38.5	39.0	38.5	37.7	2.3
27.5	34.0	34.5	35.0	34.0	33.5	34.2	35.0	36.0	37.0	39.0	39.0	37.2	3.0
30	35.0	33.0	35.5	33.5	34.5	34.3	35.5	37.0	36.5	40.0	39.5	37.7	3.4
32.5	36.0	32.0	35.0	32.0	35.0	34.0	34.5	36.5	37.5	37.5	39.0	37.0	3.0
35	35.5	35.5	36.5	32.0	34.0	34.7	36.0	35.5	37.5	36.0	38.5	36.7	2.0
37.5	36.0	37.0	36.5	32.0	37.0	35.7	37.0	35.5	39.0	36.0	39.0	37.3	1.6
40	38.0	37.0	36.0	34.0	38.0	36.5	36.0	36.0	38.0	36.0	38.5	36.9	0.4
42.5	33.0	33.0	35.0	35.0	34.0	34.0	33.0	37.0	35.0	34.0	34.0	34.6	0.6
45	33.0	35.0	34.0	31.0	32.0	33.0	32.0	34.0	32.0	32.0	36.0	33.2	0.2
47.5	--	--	--	--	--	--	--	--	--	--	--	--	--
50	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 10

Coos Bay Entrance Channel, 40-ft Project

North Half of Channel

Range 1,000 ft	Survey Depth, ft, at Indicated Date of Survey: Predredge: 1 Apr 70	7 Apr 71	15 Aug 72	20 May 74	29 Apr 76	Mean	Postdredge: 16 Aug 69	28 Aug 70	12 Jul 71	27 Sep 73	19 Jun 75	Mean	Average Infill, ft
-20	45.5	47.0	45.5	46.5	46.0	46.1	48.0	47.5	47.5	48.0	48.0	47.8	1.7
-17.5	45.5	45.0	43.5	44.5	44.0	44.5	48.0	46.5	46.0	47.5	47.5	47.1	2.6
-15	44.0	43.5	42.5	44.0	43.0	43.4	46.0	46.0	43.0	46.0	46.0	45.8	2.4
-12.5	42.0	42.5	40.5	43.0	41.5	41.9	46.0	45.0	44.0	45.5	45.0	45.1	3.2
-10	42.0	41.5	40.0	42.0	41.0	41.3	44.5	44.0	42.5	45.5	45.0	44.3	3.0
-7.5	40.5	40.5	39.5	41.0	40.0	40.3	44.5	43.0	42.0	45.0	45.0	44.1	3.8
-5	39.5	40.0	39.0	40.5	39.0	39.6	43.0	42.0	42.5	45.5	45.0	43.6	4.0
-2.5	38.5	40.0	39.5	40.5	39.0	39.5	43.5	42.5	42.0	46.5	45.0	44.0	4.5
0	38.5	40.5	37.5	40.0	38.5	39.0	42.5	42.5	43.0	46.5	45.5	44.0	5.0
2.5	38.5	44.5	37.0	40.0	38.5	39.1	41.0	42.5	43.0	49.5	46.0	44.3	5.2
5	38.5	41.5	38.5	40.5	38.0	39.4	41.0	43.5	44.0	47.5	46.5	44.5	5.1
7.5	39.0	41.5	42.0	41.0	39.0	40.5	43.0	44.5	44.0	48.0	47.0	45.3	4.8
10	39.0	41.0	46.0	43.5	42.0	42.3	45.0	44.5	46.0	50.5	49.0	47.0	4.7
12.5	37.0	42.5	50.0	45.0	41.0	43.1	46.0	47.0	49.5	53.0	50.0	49.2	6.1
15	40.0	43.0	48.0	40.5	40.3	42.4	46.5	49.0	46.0	50.0	45.5	47.4	5.0
17.5	46.5	41.5	46.5	38.5	37.3	42.1	50.0	50.0	41.3	45.0	44.4	46.2	4.1
20	45.5	43.5	47.0	37.0	38.7	42.3	42.5	43.0	40.0	43.0	44.5	42.6	0.3
22.5	38.5	38.0	46.0	36.0	37.0	39.1	40.0	42.0	41.0	45.0	44.0	42.4	3.3
25	38.5	37.0	44.0	35.3	36.0	38.2	42.0	42.5	40.7	45.0	44.0	42.8	4.6
27.5	38.0	37.0	44.3	36.7	36.3	37.9	41.5	42.5	41.0	44.7	45.0	42.9	5.0
30	38.5	38.0	40.7	37.3	38.3	38.6	42.0	42.5	40.3	45.0	45.0	43.0	4.4
32.5	38.5	38.5	42.0	38.3	39.7	39.2	42.5	42.0	41.7	42.7	44.7	42.7	3.5
35	39.5	40.5	42.3	39.3	41.3	40.6	41.5	40.5	41.3	41.0	43.0	41.5	0.0
37.5	40.0	41.0	40.7	39.3	42.3	40.7	40.5	40.0	42.3	40.0	42.7	41.1	0.4
40	39.5	39.0	39.7	40.3	40.0	39.7	37.0	38.0	40.3	40.3	39.7	39.1	-0.6
42.5	35.0	32.5	34.3	34.0	33.7	33.9	33.0	32.5	33.7	33.5	34.3	33.4	-0.5
45	32.5	34.7	33.0	32.3	32.0	32.9	33.0	33.3	33.0	33.3	33.7	33.3	0.4
47.5	37.5	38.5	39.0	37.0	38.3	38.1	41.7	38.5	35.7	39.5	41.0	39.3	1.2
50	42.5	41.5	--	--	--	42.0	41.7	43.5	--	--	--	42.6	0.6

Table 11

Coos Bay Entrance Channel, 40-ft Project

South Half of Channel

Range	Survey Depth, ft, at Indicated Date of Survey												Average
	Predredge						Postdredge						
1,000 ft	1 Apr 70	7 Apr 71	15 Aug 72	20 May 74	29 Apr 76	Mean	16 Aug 69	28 Aug 70	12 Jul 71	27 Sep 73	19 Jun 75	Mean	Infill, ft
-20	45.0	47.0	44.5	46.0	46.0	45.7	46.5	46.5	47.0	47.0	48.0	47.0	1.3
-17.5	44.5	44.5	42.5	44.0	43.5	43.8	46.5	46.0	46.0	46.5	47.0	46.4	2.6
-15	43.0	43.0	41.0	43.0	42.5	42.5	45.0	45.5	44.5	45.5	46.0	45.3	2.8
-12.5	41.5	42.0	39.5	42.0	41.0	41.2	41.5	44.5	43.5	45.0	45.0	44.5	3.3
-10	41.0	40.5	39.0	41.0	40.0	40.3	44.0	43.5	42.0	45.5	44.5	43.9	3.6
-7.5	39.0	39.5	38.5	40.0	39.5	39.3	44.0	43.0	42.0	46.0	44.5	43.9	4.6
-5	38.5	39.5	39.0	40.0	38.5	39.1	43.0	41.5	42.0	46.0	44.5	43.4	4.3
-2.5	38.0	39.5	39.0	39.5	38.5	38.9	43.0	42.0	41.5	47.0	44.5	43.6	4.7
0	38.0	40.0	38.5	39.0	38.5	38.8	42.0	42.0	42.5	47.5	45.5	43.9	5.1
2.5	38.0	44.5	38.5	39.0	38.0	39.0	41.5	43.0	43.0	48.5	46.0	44.4	5.4
5	38.0	42.0	40.0	40.0	37.5	39.4	42.0	43.5	44.5	49.0	46.5	45.1	5.6
7.5	39.0	42.0	42.5	40.5	38.5	40.4	43.5	44.5	45.0	49.5	45.4	45.8	5.4
10	40.0	42.0	46.0	41.5	40.5	42.0	43.0	45.0	47.0	51.0	48.0	47.2	5.2
12.5	38.5	42.0	48.5	43.0	40.5	42.5	46.5	48.0	48.5	52.5	40.0	49.1	6.6
15	42.5	41.0	43.5	41.0	38.5	41.3	48.0	49.5	46.0	48.5	47.0	47.8	6.5
17.5	44.0	39.0	44.5	38.0	36.0	40.3	48.5	47.0	40.5	46.0	46.0	45.6	5.3
20	38.0	37.0	44.5	35.0	36.5	38.2	40.5	43.0	40.5	46.0	46.0	43.2	5.0
22.5	37.5	38.0	43.5	36.0	37.0	38.4	40.7	44.0	41.0	47.0	47.0	43.9	5.5
25	39.5	38.0	44.5	36.0	38.0	39.2	42.5	44.5	41.3	47.3	47.3	44.6	5.4
27.5	40.5	38.5	44.3	48.3	39.0	40.1	43.5	44.5	42.7	47.3	48.0	45.3	5.1
30	41.0	40.5	43.0	39.7	41.7	41.2	42.5	44.5	43.0	47.7	48.0	45.2	3.9
32.5	42.0	42.0	44.3	42.0	44.0	42.9	44.0	45.5	44.7	47.0	48.0	45.8	2.9
35	44.0	44.5	45.3	44.3	47.3	45.1	43.5	44.5	45.0	45.3	47.0	45.2	0.0
37.5	42.5	45.0	45.0	44.3	46.0	44.6	42.0	43.0	44.3	44.3	45.3	43.8	-0.8
40	38.5	40.0	39.3	40.0	39.0	39.4	35.7	38.0	39.7	40.7	39.7	38.8	-0.6
42.5	33.0	32.4	34.0	32.7	33.3	33.1	33.0	32.4	34.0	34.0	34.3	33.6	0.5
45	32.5	32.4	33.3	32.7	34.0	33.0	32.5	33.0	33.3	32.7	33.0	32.9	-0.1
47.5	32.5	33.5	34.0	33.0	31.5	33.1	35.3	34.5	35.0	33.0	33.3	34.2	1.1
50	44.5	44.0	--	--	--	44.3	--	43.5	--	--	--	43.5	-0.8

Table 12

Coos Bay Entrance Channel, 40-ft Project

South Flare

Range	Survey Depth, ft, at Indicated Date of Survey												Average
	Predredge						Postdredge						
1,000 ft	1 Apr 70	7 Apr 71	15 Aug 72	20 May 74	29 Apr 76	Mean	16 Aug 69	28 Aug 70	12 Jul 71	27 Sep 73	19 Jun 75	Mean	Infill, ft
-20	44.0	46.0	43.7	44.3	44.7	44.5	43.0	45.3	46.3	46.7	46.7	45.6	1.1
-17.5	42.3	43.3	41.7	43.0	43.0	42.7	42.0	44.3	45.3	46.0	46.3	44.8	2.1
-15	41.3	42.7	39.7	41.7	41.7	41.4	41.5	44.0	44.0	45.0	45.3	44.0	2.6
-12.5	40.0	41.3	38.3	40.7	40.0	40.1	41.5	43.7	43.0	45.0	44.7	43.6	3.5
-10	39.0	39.7	37.3	39.3	39.3	38.9	41.0	42.7	42.0	44.5	44.3	42.9	4.0
-7.5	37.3	39.7	37.3	38.7	38.7	38.3	40.5	42.0	42.3	44.5	44.3	42.5	4.2
-5	37.0	38.7	37.3	38.0	37.7	37.7	39.5	42.0	41.0	45.0	45.0	42.5	4.8
-2.5	36.3	38.3	37.7	37.3	37.7	37.5	40.5	42.3	40.7	44.5	45.0	42.6	5.1
0	36.0	38.7	36.0	37.0	37.7	37.1	39.5	42.3	41.3	44.5	45.7	42.7	5.6
2.5	36.3	40.0	36.5	37.0	37.0	37.4	40.5	43.7	42.7	45.0	45.5	43.5	6.1
5	37.0	41.3	38.5	37.7	36.5	38.2	41.5	41.0	44.0	46.0	45.0	44.1	5.9
7.5	37.5	41.7	42.0	37.0	38.0	39.2	42.5	45.0	45.0	47.0	46.0	45.1	5.9
10	38.5	41.7	43.5	37.5	38.0	39.8	43.5	46.5	43.7	48.0	46.5	45.6	5.8
12.5	40.3	41.5	42.5	38.5	39.5	40.5	46.4	49.0	47.0	48.0	47.0	47.5	7.0
15	43.0	41.0	37.0	40.5	40.0	40.3	47.0	49.3	46.0	44.5	46.0	46.6	6.3
17.5	40.0	38.0	38.0	38.0	34.5	37.7	41.5	43.0	39.0	44.0	45.0	42.5	4.8
20	35.0	35.0	36.5	33.5	34.5	34.9	40.0	44.5	40.0	45.5	46.0	42.6	7.7
22.5	36.5	36.5	39.0	34.5	35.5	36.4	40.5	43.0	39.5	47.0	46.0	43.2	6.8
25	39.5	37.5	39.0	35.5	38.0	37.9	41.5	42.5	40.0	47.5	46.0	43.5	5.6
27.5	40.0	38.5	42.0	37.7	40.0	39.5	41.5	43.0	42.5	47.4	46.0	44.1	4.6
30	41.0	40.5	43.0	39.5	42.0	41.2	43.0	43.0	43.5	46.0	45.5	44.2	3.0
32.5	43.0	42.5	45.0	42.5	45.0	43.6	44.5	45.0	44.0	47.0	47.0	45.5	1.9
35	46.0	44.0	46.0	46.0	47.0	45.8	44.0	46.0	45.5	48.0	47.0	46.1	0.3
37.5	43.0	41.0	45.0	45.5	44.0	43.7	43.0	44.0	42.0	44.0	44.0	43.4	-0.3
40	37.0	38.0	39.0	41.5	37.0	38.5	33.0	38.0	38.0	39.0	36.0	36.8	-1.7
42.5	32.0	32.0	30.0	31.0	27.0	30.4	30.0	30.0	31.0	32.0	30.0	30.6	0.2
45	32.0	30.0	28.0	28.0	28.0	29.2	32.0	30.0	30.0	32.0	26.0	30.0	0.8
47.5	--	--	--	--	--	--	--	--	--	--	--	--	--
50	--	--	--	--	--	--	--	--	--	--	--	--	--

Table 13

Coos Bay Entrance Channel, 45-ft Project, North Flare

Range 1,000 ft	Survey Depth, ft, at Indicated Date of Survey: Predredge: 17 May 77	Predredge: 24 May 78	Predredge: 18 Apr 79	Predredge: Mean	Postdredge: 11 Aug 76	Postdredge: 13 Sep 77	Postdredge: 12 Sep 78	Postdredge: Mean	Average Infill, ft
-20	48.3	36.0	--	47.2	50.7	51.0	48.0	49.9	[illegible].7
-17.5	46.7	44.7	48.3	46.6	49.7	50.0	48.0	49.2	2.[illegible]
-15	46.7	44.0	47.3	46.0	49.0	59.3	47.3	48.5	2.5
-12.5	45.7	43.5	46.7	45.3	48.3	47.7	46.7	47.6	2.3
-10	45.0	42.5	46.7	44.7	47.3	47.7	46.3	47.1	2.5
-7.5	44.0	41.5	46.3	43.9	46.3	47.7	45.7	46.6	2.7
-5	43.0	41.0	45.7	43.2	44.0	47.0	45.3	45.4	2.2
-2.5	42.7	41.0	45.3	43.0	43.0	47.0	45.3	45.1	2.1
0	42.3	41.5	45.0	42.9	43.0	46.5	46.3	45.3	2.4
2.5	42.0	42.0	44.0	42.7	41.5	46.0	47.0	44.8	2.1
5	41.0	42.0	43.5	42.2	41.5	44.5	47.3	44.4	2.2
7.5	40.8	42.5	43.5	42.2	40.5	43.0	48.7	44.1	1.9
10	42.0	48.5	50.5	47.0	47.0	47.0	51.5	48.5	1.5
12.5	41.0	51.0	55.5	49.2	51.5	52.5	54.0	52.7	3.5
15	44.7	45.0	43.5	44.4	43.5	49.0	51.0	47.8	3.4
17.5	44.0	37.0	41.5	40.8	46.0	45.0	46.0	45.7	4.9
20	45.0	42.0	47.5	44.8	48.5	48.0	47.5	48.0	3.2
22.5	42.0	38.5	44.5	41.7	43.5	45.0	46.5	45.0	3.3
25	36.5	36.0	39.5	37.3	40.5	40.5	46.5	42.5	5.2
27.5	34.5	36.0	37.0	35.8	40.0	39.0	46.5	38.5	2.7
30	34.5	36.5	36.5	35.8	40.0	40.0	45.5	41.8	6.0
32.5	34.5	34.0	36.5	35.0	40.0	40.0	43.5	41.2	6.2
35	36.0	34.0	37.5	35.8	40.0	41.5	40.5	40.7	4.9
37.5	38.5	35.0	40.0	37.8	41.5	42.5	40.0	44.3	3.5
40	39.0	40.0	41.0	40.0	40.5	40.0	40.5	40.3	0.3
42.5	35.0	34.0	40.0	36.3	35.0	35.5	39.0	36.5	0.2
45	32.0	32.0	39.0	34.3	33.0	33.0	38.0	34.7	0.4
47.5	--	--	--	--	--	--	--	--	--
50	--	--	--	--	--	--	--	--	--

Table 14

Coos Bay Entrance Channel, 45-ft Project, North Half of Channel

Range 1,000 ft	Survey Depth, ft, at Indicated Date of Survey: Predredge 17 May 77	24 May 78	18 Apr 79	Mean	Postdredge 11 Aug 76	13 Sep 77	12 Sep 78	Mean	Average Infill, ft
-20	47.5	44.5	--	46.0	51.5	50.0	48.0	49.8	3.8
-17.5	45.5	43.5	48.0	45.7	51.5	59.0	48.0	49.5	3.8
-15	46.0	42.5	47.5	45.3	51.0	48.5	48.0	49.2	3.9
-12.5	44.5	41.0	47.0	44.2	50.0	46.5	47.5	48.0	3.8
-10	44.0	40.5	46.0	43.5	50.0	46.5	47.5	48.0	4.5
-7.5	43.0	40.0	45.5	42.8	49.5	46.5	46.5	47.5	4.7
-5	42.6	39.0	46.0	42.5	49.5	46.5	46.0	47.3	4.8
-2.5	42.0	38.5	45.5	42.0	49.5	46.0	46.5	47.3	5.3
0	42.5	39.0	46.0	42.5	50.0	47.5	47.5	48.3	5.8
2.5	42.5	40.0	45.5	42.7	49.5	47.0	48.5	48.3	5.6
5	43.0	41.5	45.5	43.3	49.5	48.0	49.5	49.0	5.7
7.5	44.0	42.5	48.0	44.8	51.0	49.5	51.0	50.5	5.7
10	45.0	46.0	52.0	47.7	53.5	51.0	52.5	52.5	4.8
12.5	45.0	49.5	53.5	49.3	55.5	53.0	54.5	54.5	5.2
15	49.0	44.3	49.5	47.6	51.0	55.0	52.7	52.7	5.1
17.5	44.5	36.3	44.5	41.8	51.0	49.0	49.5	49.5	7.7
20	40.0	37.3	46.0	41.1	50.5	46.0	48.2	48.2	7.1
22.5	40.0	35.3	45.0	40.4	50.5	48.0	49.1	49.1	8.7
25	41.0	37.3	43.7	40.7	50.5	49.0	49.5	49.5	8.8
27.5	39.7	37.7	41.7	39.7	48.0	45.5	47.5	47.5	7.8
30	37.7	39.7	41.3	39.6	48.0	46.0	47.3	47.3	7.7
32.5	38.0	40.0	42.0	40.0	47.7	44.3	46.2	46.2	6.2
35	40.0	40.3	42.3	40.9	46.7	46.7	46.0	46.0	5.1
37.5	42.7	40.3	41.7	41.6	46.0	47.0	45.6	45.6	4.0
40	40.7	40.7	41.7	41.0	42.3	42.3	42.0	42.0	1.0
42.5	35.3	36.7	39.7	37.2	34.3	34.3	36.0	36.0	-1.2
45	32.3	33.0	40.3	35.3	34.0	33.3	35.7	35.7	0.5
47.5	36.3	40.3	42.0	39.5	41.3	34.0	38.8	38.8	-0.7
50	--	46.0	--	46.0	--	45.5	--	45.5	-0.5

Table 15

Coos Bay Entrance Channel, 45-ft Project, South Half of Channel

Range	Survey Depth, ft, at Indicated Date of Survey								Average
	Predredge				Postdredge				
1,000 ft	17 May 77	24 May 78	18 Apr 79	Mean	11 Aug 76	13 Sep 77	12 Sep 78	Mean	Infill, ft
-20	47.0	46.5	--	46.8	51.5	49.0	48.0	49.5	2.7
-17.5	45.5	45.0	47.5	46.0	51.5	48.5	48.0	49.3	3.3
-15	45.5	44.0	46.5	45.3	51.0	47.5	47.5	48.7	3.4
-12.5	44.0	42.5	46.5	44.3	50.5	47.0	47.0	48.2	3.9
-10	43.5	42.0	46.0	43.8	50.0	46.5	46.5	47.7	3.9
-7.5	42.0	41.0	44.5	42.5	49.5	46.0	46.0	47.2	4.7
-5	41.5	40.0	45.0	42.2	50.0	46.5	46.0	47.5	5.3
-2.5	41.5	40.0	45.5	42.3	50.0	46.5	47.0	47.8	5.5
0	42.0	40.0	45.0	42.3	50.5	47.5	48.0	48.7	6.4
2.5	42.5	41.5	45.5	43.2	50.5	47.5	48.5	48.8	5.6
5	42.5	43.5	46.5	44.2	51.5	49.0	50.0	50.2	6.0
7.5	43.5	45.0	48.5	45.7	53.5	50.0	51.0	51.7	6.0
10	43.7	47.5	51.0	47.4	54.5	51.5	52.5	52.8	5.4
12.5	44.3	46.0	50.0	46.8	55.0	54.0	53.0	54.0	7.2
15	46.3	40.5	48.5	45.1	54.0	53.5	50.0	52.5	7.4
17.5	43.3	37.0	45.5	41.9	53.0	48.5	48.5	50.0	8.1
20	32.7	37.5	44.0	39.7	52.0	47.0	48.0	49.0	9.3
22.5	39.7	38.5	45.0	41.1	52.5	49.5	49.0	50.3	9.2
25	41.7	39.3	45.3	42.2	52.5	49.0	49.0	50.2	8.0
27.5	43.7	41.5	46.7	44.0	52.3	48.0	38.3	49.5	5.5
30	42.0	44.0	45.7	43.9	51.7	47.3	47.7	48.9	5.0
32.5	42.7	46.7	47.3	45.6	51.3	48.3	48.0	49.2	3.8
35	45.3	48.0	48.0	47.1	40.7	49.7	48.0	49.5	2.4
37.5	46.0	46.0	45.3	45.8	48.3	47.0	46.0	47.1	1.3
40	39.7	39.0	40.7	39.8	41.0	40.0	41.0	40.7	0.9
42.5	33.5	35.0	40.7	36.4	34.3	34.3	39.0	35.9	-0.5
45	33.0	33.3	40.7	35.7	34.0	32.5	39.7	35.4	-0.3
47.5	33.0	34.5	41.0	36.2	39.0	34.7	40.0	39.7	1.7
50	--	46.0	--	46.0	--	46.0	--	46.0	0.0

Table 16

Coos Bay Entrance Channel, 45-ft Project, South Flare

Range	Survey Depth, ft, at Indicated Date of Survey								Average
	Predredge				Postdredge				
1,000 ft	17 May 77	24 May 78	18 Apr 79	Mean	11 Aug 76	13 Sep 77	12 Sep 78	Mean	Infill, ft
-20	47.3	47.3	--	47.3	50.3	49.0	47.2	49.0	1.7
-17.5	43.7	45.7	46.3	45.2	50.0	48.0	42.0	48.3	3.1
-15	43.0	44.3	45.0	44.1	49.0	47.0	46.3	47.4	3.3
-12.5	41.5	43.7	44.0	43.1	48.7	46.0	46.3	47.0	3.9
-10	39.5	42.3	44.3	42.0	48.3	45.5	45.7	46.5	4.5
-7.5	39.0	40.7	43.3	41.0	48.3	45.5	45.7	46.5	5.5
-5	39.0	39.7	42.3	40.3	48.7	45.5	45.3	46.5	6.2
-2.5	39.0	39.7	44.0	49.0	48.3	46.0	46.0	46.8	5.9
0	39.5	40.0	43.3	40.9	48.7	47.0	47.0	47.6	6.7
2.5	39.5	41.7	43.5	41.6	49.0	47.5	47.3	47.9	6.3
5	41.0	43.0	43.5	42.5	49.5	49.0	48.7	49.1	6.6
7.5	40.5	45.0	45.0	43.5	50.5	50.0	49.7	50.1	6.6
10	42.0	45.5	46.5	44.7	51.5	51.0	50.0	50.8	6.1
12.5	43.0	44.5	44.5	44.0	51.0	51.0	48.0	50.0	6.0
15	43.0	38.0	46.5	42.5	50.0	50.0	46.5	48.8	6.3
17.5	41.5	37.5	44.0	41.0	48.5	47.0	46.0	47.2	6.2
20	37.0	38.0	41.5	38.8	49.0	47.5	46.5	47.7	8.9
22.5	39.5	38.0	43.0	40.2	49.5	47.5	46.5	47.8	7.6
25	40.0	39.0	44.0	41.0	50.5	46.5	45.5	47.5	6.5
27.5	42.0	41.0	46.0	43.0	51.0	47.0	45.5	47.8	4.8
30	40.5	43.5	47.0	43.7	51.0	47.0	45.0	47.7	4.0
32.5	43.0	47.0	48.0	46.0	40.5	48.5	47.5	48.8	2.8
35	46.0	48.5	49.0	47.8	48.0	48.5	47.5	48.0	0.2
37.5	44.0	46.5	47.0	45.8	36.0	43.0	44.5	41.2	-4.6
40	40.0	41.3	42.3	44.1	32.0	41.0	41.0	38.0	-3.1
42.5	30.0	33.5	40.0	34.5	27.0	31.0	39.0	32.3	-2.2
45	33.0	24.0	40.0	34.3	33.0	29.0	39.0	33.7	1.4
47.5	--	--	--	--	--	--	--	--	--
50	--	--	--	--	--	--	--	--	--

Table 17

Coquille River Entrance Channel, 13-ft Project Predredge Survey Depths, North and South Flares

Range	Survey Depth, ft, at Indicated Date of Survey														
100 ft	11 Apr 62	10 Apr 63	5 Aug 65	15 Apr 65	23 Apr 66	20 Apr 67	1 May 68	24 Apr 70	30 Apr 71	30 Mar 72	17 May 73	21 May 74	6 May 78	31 May 79	7 Apr 80	Mean
								North Flare								
-20	--	--	--	--	--	--	--	32.0	29.5	28.5	--	31.7	33.2	--	32.0	31.2
-17.5	--	--	--	--	--	--	--	30.0	26.5	27.0	--	30.0	31.0	--	31.0	29.3
-15	--	--	--	--	--	--	--	27.0	24.0	25.5	--	27.7	28.5	26.0	27.0	26.5
-12.5	25.5	23.7	22.3	22.0	23.0	19.5	22.3	22.5	20.5	22.5	18.0	25.0	25.5	23.0	22.0	22.5
-10	21.0	20.7	19.0	18.7	18.7	16.0	19.0	19.5	15.5	17.5	14.5	22.0	21.3	19.5	18.0	18.7
-7.5	15.0	16.0	18.0	15.0	14.7	13.5	15.7	19.5	15.5	13.5	16.0	17.3	15.3	13.0	22.5	16.0
-5	14.0	14.0	17.0	13.0	16.0	14.0	9.5	19.0	14.5	11.0	14.5	14.7	16.3	14.0	19.5	14.7
-2.5	13.0	12.5	12.0	13.0	13.0	11.5	12.5	18.5	11.0	12.0	--	18.5	15.5	12.0	18.0	13.8
0	10.0	10.5	9.5	11.0	10.0	9.5	14.0	15.0	9.0	14.0	--	16.5	12.0	9.0	12.5	11.6
2.5	14.0	14.0	13.5	11.0	13.0	14.0	10.0	17.0	14.0	15.0	--	12.5	12.5	13.0	12.5	13.3
5	15.0	15.0	15.0	16.0	16.0	17.0	14.0	14.0	16.0	18.0	--	15.0	14.5	15.0	17.0	15.5
								South Flare								
-20	--	--	--	--	--	--	--	31.5	29.0	29.0	29.7	30.8	31.7	--	--	30.3
-17.5	--	--	--	--	--	--	--	28.0	26.5	27.5	28.0	28.8	29.7	--	--	28.1
-15	--	--	--	--	--	--	--	25.5	24.5	24.5	24.3	26.0	28.3	25.0	27.0	25.6
-12.5	22.0	22.0	19.0	20.3	22.0	19.3	21.3	22.0	21.0	21.0	19.0	23.3	25.3	21.7	22.5	21.4
-10	18.7	18.3	16.0	16.3	17.3	15.7	17.0	18.5	16.0	17.5	14.7	21.0	21.7	15.7	18.0	17.5
-7.5	14.3	16.0	16.5	16.7	18.3	13.7	15.5	19.0	13.5	14.0	14.7	17.0	16.0	15.7	19.0	16.0
-5	14.0	13.0	17.0	18.0	18.3	13.0	18.5	19.0	13.0	13.0	18.0	11.3	12.7	15.3	17.5	15.5
-2.5	14.3	12.3	16.5	18.0	17.3	16.7	18.0	18.0	18.5	11.0	19.0	17.7	13.5	18.5	20.0	16.6
0	16.3	15.0	17.0	17.3	19.0	17.0	16.5	18.5	17.0	14.0	17.7	18.3	18.5	16.5	19.0	17.2
2.5	14.0	14.5	15.0	16.3	19.5	16.0	16.0	16.0	14.5	17.0	17.5	16.5	18.5	15.0	16.0	16.2
5	15.0	14.0	14.0	14.3	17.0	14.0	14.0	15.0	15.0	15.0	15.5	14.0	15.5	14.5	15.0	14.8

Table 18

Coquille River Entrance Channel, 13-ft Project Predredge Survey Depths, North and South Halves of Channel

Range 100 ft	Survey Depth, ft, at Indicated Date of Survey: 11 Apr 62	10 Apr 63	5 Aug 65	15 Apr 65	23 Apr 66	20 Apr 67	1 May 68	24 Apr 70	30 Apr 71	30 Mar 72	17 May 73	21 May 74	6 May 78	31 May 79	7 Apr 80	Mean
								North Half of Channel								
-20	--	--	--	--	--	--	--	32.0	28.0	29.0	--	31.0	33.0	--	32.5	30.9
-17.5	--	--	--	--	--	--	--	30.0	27.0	27.0	--	29.0	31.0	--	29.5	28.9
-15	--	--	--	--	--	--	--	27.0	24.0	26.0	--	26.5	28.5	25.5	27.0	26.4
-12.5	22.5	22.0	20.5	22.0	23.3	19.0	23.0	23.0	20.0	22.0	18.0	25.0	25.5	21.0	21.5	21.9
-10	20.0	19.0	17.0	17.0	18.3	18.0	20.0	19.0	15.0	17.0	14.0	21.3	21.5	15.5	17.5	18.0
-7.5	14.0	15.3	18.5	15.0	15.7	13.5	15.0	20.5	15.0	13.5	15.5	16.7	16.0	13.0	23.0	16.0
-5	14.5	13.0	15.0	14.0	16.3	12.5	12.5	20.5	13.5	11.0	14.0	13.3	15.0	18.0	20.0	14.6
-2.5	14.3	12.5	11.7	13.7	11.0	12.5	14.3	20.5	15.0	12.5	11.0	18.5	14.5	13.0	18.0	14.2
0	12.5	13.0	10.7	13.0	13.7	12.5	12.0	17.5	14.0	16.0	11.0	19.0	15.3	12.7	15.0	13.9
2.5	13.7	13.0	14.7	14.3	17.0	17.0	13.3	17.0	14.0	19.0	11.0	16.5	15.0	16.3	17.0	15.1
5	17.7	15.0	15.3	17.0	18.7	17.3	16.0	18.0	17.3	19.0	--	16.5	16.7	16.5	18.0	17.1
7.5	14.0	13.3	13.5	14.3	14.3	13.7	14.5	14.3	14.3	14.3	12.3	14.3	14.3	14.0	15.3	14.0
10	14.7	13.0	12.7	13.7	15.0	13.7	13.3	14.0	15.0	15.0	11.7	15.0	12.7	14.0	14.7	13.9
12.5	13.3	13.3	13.0	13.0	--	14.3	13.7	14.0	14.0	15.0	11.7	14.5	13.0	14.7	14.0	13.7
15	14.3	13.0	13.0	12.0	--	14.7	14.0	13.5	13.0	14.3	12.3	14.0	13.3	15.0	15.3	13.7
17.5	13.3	13.0	12.7	11.7	--	13.3	13.3	13.0	12.7	13.0	11.7	12.3	13.0	14.5	14.0	13.0
20	13.3	13.0	13.0	11.7	--	13.5	13.3	13.0	12.7	12.7	11.7	12.3	12.7	14.5	14.3	13.0
22.5	13.7	13.0	13.7	12.7	--	14.3	13.7	12.3	12.0	12.7	12.7	13.3	13.3	14.7	15.3	13.5
25	14.3	13.3	14.0	14.0	--	15.3	14.7	14.0	14.3	14.0	13.3	13.7	14.0	15.7	15.3	14.3
27.5	15.7	14.7	14.3	15.7	--	16.3	16.0	15.0	15.3	15.0	14.7	15.0	14.7	17.0	16.7	15.4
30	16.7	15.7	15.7	16.3	--	17.3	17.7	16.3	16.7	15.7	16.0	17.0	16.3	17.7	17.7	16.6
32.5	17.7	16.0	17.0	17.0	--	18.3	18.7	17.0	17.7	17.0	17.0	18.3	17.3	19.3	19.0	17.7
35	17.0	16.0	16.7	17.7	--	18.0	19.0	19.0	19.0	17.0	18.0	18.7	18.0	19.0	18.7	18.1
								South Half of Channel								
-20	--	--	--	--	--	--	--	32.0	28.0	29.0	30.0	30.5	33.5	--	--	30.5
-17.5	--	--	--	--	--	--	--	30.7	27.0	27.0	27.5	28.5	30.5	--	--	28.4
-15	--	--	--	--	--	--	--	27.0	24.0	25.5	24.0	26.5	28.5	26.0	27.0	26.1
-12.5	21.5	21.5	19.0	21.5	23.0	19.0	22.0	23.0	20.0	21.0	18.0	24.0	25.5	22.0	21.0	21.5
-10	19.5	17.5	16.0	16.0	17.0	16.0	18.0	19.0	15.0	17.0	15.0	20.5	32.0	17.0	17.0	17.6
-7.5	13.5	15.5	18.0	15.0	16.5	13.0	14.0	21.0	14.0	13.0	15.5	16.5	16.0	14.0	21.5	15.8
-5	15.0	13.0	14.5	13.5	17.0	13.0	14.0	21.0	13.0	12.0	15.0	12.0	14.0	13.0	20.5	14.8
-2.5	15.5	12.7	12.0	15.0	12.5	13.0	15.0	20.5	20.0	12.0	17.5	20.5	15.5	14.5	20.0	15.4
0	17.0	15.0	16.7	15.7	17.0	15.7	13.5	19.5	16.5	16.5	15.7	19.5	19.3	15.0	18.0	16.7
2.5	15.0	15.0	15.0	16.0	19.0	17.7	16.3	17.5	14.0	18.5	18.0	16.0	17.7	15.5	17.0	16.6

(Continued)

Table 18 (Concluded)

Range 100 ft	Survey Depth, ft, at Indicated Date of Survey															
	11 Apr 62	10 Apr 63	5 Aug 65	15 Apr 65	23 Apr 66	20 Apr 67	1 May 68	24 Apr 70	30 Apr 71	30 Mar 72	17 May 73	21 May 74	6 May 78	31 May 79	7 Apr 80	Mean
	South Half of Channel (Continued)															
5	15.7	14.0	14.5	16.7	18.7	17.0	17.7	17.0	17.0	18.0	15.3	16.5	17.3	17.0	17.0	16.6
7.5	14.0	13.0	13.0	13.5	15.0	14.5	14.3	14.0	14.3	13.7	13.8	13.7	14.0	13.0	14.0	13.9
10	14.0	12.7	12.7	13.3	15.3	14.3	13.0	13.0	14.3	14.0	12.7	13.7	13.7	14.8	13.3	13.8
12.5	13.3	12.7	13.0	13.0	--	14.7	13.7	13.3	14.3	15.0	12.7	13.7	13.3	14.7	14.0	13.7
15	13.7	12.0	13.0	12.7	--	14.0	13.0	12.7	13.0	12.7	12.0	12.3	12.3	13.8	14.3	13.0
17.5	13.3	11.3	12.3	12.0	--	13.0	11.7	12.0	12.7	12.3	11.0	11.7	12.3	14.5	13.3	12.4
20	13.0	11.7	12.7	12.3	--	13.7	12.3	11.7	12.3	12.3	11.7	11.7	12.3	15.0	13.7	12.6
22.5	12.7	12.0	13.0	13.3	--	14.3	13.0	12.7	13.3	13.0	12.0	12.3	12.7	14.7	14.0	13.1
25	13.0	12.3	13.3	14.0	--	15.0	13.7	13.7	13.7	14.0	12.7	13.0	13.0	15.3	14.7	13.7
27.5	13.7	13.7	13.0	14.3	--	15.3	14.7	14.7	14.0	12.0	13.0	12.3	12.0	15.0	14.0	13.7
30	12.3	11.7	11.7	14.0	--	13.0	13.7	11.5	12.0	11.7	11.3	12.0	12.0	13.0	12.7	12.3
32.5	15.0	14.0	13.7	14.7	--	15.7	15.0	14.0	15.3	14.0	15.0	15.0	15.3	15.3	16.0	14.9
35	16.7	16.0	16.7	17.3	--	17.0	17.0	16.5	17.7	16.3	16.7	17.3	16.3	17.3	17.7	16.9

Table 19

Siuslaw River Entrance Channel, 12-ft Project, North and South Halves of Channel

Range	Predredge Survey Depth, ft, at Indicated Date of Survey											
	North Half of Channel						South Half of Channel					
1,000 ft	15 May 64	29 Apr 65	29 Apr 66	15 Apr 67	8 Jun 68	Mean	15 May 64	29 Apr 65	29 Apr 66	15 Apr 67	8 Jun 68	Mean
-30	--	--	--	--	--	--	--	--	--	--	--	--
-27.5	24.5	23.0	22.0	--	23.7	23.3	24.3	24.3	21.5	--	22.0	23.0
-25	19.8	17.7	20.5	15.0	16.0	17.8	18.3	18.3	20.0	13.3	12.3	16.4
-22.5	12.8	14.7	19.5	13.0	11.0	14.2	13.0	14.3	20.0	11.7	10.3	13.9
-20	15.5	13.3	16.5	10.7	12.0	13.6	16.0	14.0	13.5	12.0	13.3	14.2
-17.5	14.3	14.0	17.0	12.3	15.0	14.5	13.7	12.7	17.0	11.0	14.7	13.8
-15	14.8	14.3	16.5	15.0	17.7	15.7	14.5	16.7	14.5	10.7	14.3	14.1
-12.5	22.5	17.3	24.5	16.8	20.7	20.4	11.5	13.7	17.0	12.7	16.7	14.3
-10	13.0	19.7	21.5	17.5	22.3	18.8	10.0	14.0	11.0	10.3	15.0	12.1
-7.5	14.0	19.7	21.0	18.3	21.7	18.9	9.7	12.7	10.5	11.3	14.7	11.8
-5	14.5	17.3	22.0	19.7	24.3	19.6	10.3	15.3	12.5	12.8	13.0	12.8
-2.5	16.3	20.7	24.5	20.3	25.3	21.4	11.7	11.7	11.0	12.8	14.0	12.2
0	19.0	21.7	26.0	23.0	23.3	22.6	13.0	14.0	15.0	15.5	17.3	15.0
2.5	21.3	23.7	28.0	25.7	26.7	25.1	15.0	16.5	19.0	14.3	14.7	15.9
5	19.8	25.3	29.0	26.0	26.3	25.3	14.3	17.0	14.7	12.5	11.7	14.0
7.5	21.0	26.5	29.0	26.3	29.7	26.5	14.3	13.0	16.3	11.0	14.0	13.7
10	21.0	28.0	30.3	25.7	27.3	26.5	14.0	17.0	17.0	10.8	13.7	14.5
12.5	23.3	30.0	31.3	27.7	27.0	27.9	16.7	18.5	18.0	14.3	15.3	16.5
15	24.3	27.0	32.3	29.0	26.0	27.7	15.3	20.0	17.7	13.7	16.0	16.5
17.5	23.0	27.0	26.7	22.0	21.5	24.0	17.2	16.3	13.7	13.0	14.0	14.8
20	21.5	25.0	24.0	20.3	19.0	22.0	19.7	16.3	14.3	12.7	15.0	15.6
22.5	38.7	40.0	34.0	22.7	38.5	34.8	28.3	17.3	16.3	12.5	14.3	17.8
25	27.5	23.0	23.5	18.0	25.0	23.4	13.3	13.6	13.0	12.0	12.0	12.8
27.5	13.0	12.8	12.3	11.0	13.0	12.4	10.5	13.2	13.5	12.5	11.7	12.3
30	12.8	13.7	13.0	11.5	11.0	12.4	8.5	13.5	14.7	13.0	12.5	12.4
32.5	13.0	14.0	14.5	11.7	12.3	13.1	11.8	15.5	15.5	14.5	15.0	14.5
35	16.0	19.0	15.7	13.0	13.5	15.4	12.5	18.0	18.5	16.3	18.0	16.7
37.5	20.0	18.7	18.5	15.0	18.0	18.0	16.0	22.0	21.0	21.0	23.0	20.6
40	18.8	20.0	19.7	20.0	21.3	20.0	22.5	26.5	28.0	29.0	30.0	27.2

Table 20

Siuslaw River Entrance Channel, 18-ft Project, Predredge Survey Depths, North and South Halves of Channel

Range	Predredge Survey Depth, ft, at Indicated Date of Survey												
1,000 ft	22 Apr 70	26 Apr 71	3 Apr 72	25 Apr 73	30 Apr 74	27 Apr 76	18 Aug 77	31 May 78	3 May 79	11 Jun 80	8 May 81	3 Jun 82	Mean
						North Half of Channel							
-30	--	--	--	--	--	32.3	29.7	30.0	28.3	30.3	28.7	30.0	29.9
-27.5	23.7	--	24.3	22.3	--	27.0	25.0	24.3	26.0	26.3	23.7	26.0	24.9
-25	20.0	23.7	24.0	15.3	--	21.0	22.7	17.3	22.0	21.0	18.3	21.7	20.7
-22.5	16.3	17.0	19.3	19.0	16.5	16.0	23.7	12.7	18.0	13.7	16.8	17.0	17.2
-20	19.0	18.3	17.7	18.7	18.3	17.7	25.0	23.3	13.0	13.7	21.0	16.3	18.5
-17.5	19.0	25.0	16.0	16.0	13.7	15.3	18.7	16.7	16.7	9.7	17.0	18.0	16.8
-15	18.0	17.3	15.0	13.0	14.0	14.3	10.3	10.0	21.0	13.0	19.3	23.3	15.7
-12.5	17.3	16.3	19.0	13.3	21.0	16.3	29.3	10.0	32.7	13.0	24.7	29.3	20.1
-10	20.0	22.7	23.7	18.3	24.7	17.3	16.7	20.0	17.7	15.0	18.7	21.3	19.7
-7.5	19.7	23.0	23.7	19.7	24.7	14.3	18.7	20.3	18.0	14.0	16.3	21.7	19.5
-5	20.7	25.0	25.7	21.3	25.0	16.0	21.3	22.7	20.7	15.7	16.3	21.7	21.0
-2.5	16.8	24.7	27.0	22.0	27.0	16.7	23.0	26.0	20.3	18.7	19.3	22.0	22.0
0	22.0	27.0	28.3	23.3	27.7	20.3	25.3	20.7	21.3	21.7	22.3	23.7	23.6
2.5	27.0	28.0	33.0	28.3	30.0	25.0	28.3	25.0	25.0	26.2	26.0	26.7	27.4
5	30.7	31.0	33.7	31.7	31.8	29.3	29.3	26.7	28.3	29.0	29.3	30.3	30.1
7.5	27.3	32.0	35.0	33.0	32.0	31.0	31.0	27.3	30.0	29.3	31.3	31.7	30.9
10	27.3	30.3	34.0	33.7	32.0	33.0	33.3	30.0	32.7	33.3	33.0	32.3	32.3
12.5	26.7	31.0	34.0	34.3	33.4	34.0	40.7	34.3	36.0	36.3	34.0	35.0	34.1
15	24.3	27.7	29.3	32.0	32.3	35.3	37.0	35.0	36.7	36.7	33.7	38.3	33.2
17.5	20.0	22.3	23.3	25.7	28.3	29.7	30.0	32.7	36.7	35.0	35.7	36.0	29.6
20	16.3	18.0	21.0	21.7	25.0	25.7	25.7	27.7	26.7	24.7	25.3	26.3	23.7
22.5	30.3	30.0	23.7	34.3	37.3	34.0	41.4	46.0	38.3	46.0	45.5	41.3	37.3
25	15.7	21.0	19.3	21.3	21.7	20.3	27.7	28.0	23.0	21.3	24.3	29.7	22.4
27.5	11.0	13.0	13.0	14.0	13.3	14.3	17.0	16.0	16.0	15.7	16.0	15.7	14.7
30	11.7	13.0	13.3	13.7	14.0	15.0	15.3	15.7	15.3	15.3	15.0	15.3	14.4
32.5	13.0	14.3	14.0	14.3	14.3	15.3	15.0	15.0	15.0	15.0	14.7	15.0	14.6
35	15.7	17.7	16.7	16.7	18.3	18.0	17.3	18.3	18.7	20.0	17.7	19.0	17.8
37.5	19.0	21.0	20.0	23.3	21.0	19.7	18.7	19.3	19.7	21.0	19.0	20.0	20.1
40	20.0	25.3	21.7	23.7	21.5	20.0	18.0	17.7	20.7	19.0	--	18.3	20.5
						South Half of Channel							
-30	--	--	--	--	--	32.0	28.0	30.3	28.0	30.0	28.5	30.3	29.6
-27.5	24.0	--	23.8	21.5	--	26.8	23.5	24.8	25.5	25.3	23.3	25.3	24.0
-25	18.3	23.3	24.0	15.3	--	21.0	22.0	17.8	22.3	20.8	18.8	20.3	20.4
-22.5	17.8	18.3	19.3	18.3	16.0	16.0	23.3	14.8	16.3	13.3	19.0	16.5	17.4
-20	18.3	18.5	17.0	18.0	17.3	17.8	17.3	20.8	14.3	12.3	19.8	15.5	17.2
-17.5	18.3	20.5	16.0	14.3	15.0	16.3	15.8	13.0	17.0	9.8	15.8	16.5	15.7
-15	17.3	18.3	14.3	13.0	14.5	14.8	22.0	13.7	18.0	13.8	17.0	19.0	16.4
-12.5	15.3	16.0	16.5	12.0	16.3	13.3	22.3	16.0	15.5	10.0	13.0	26.5	16.1
-10	13.3	13.3	17.5	13.0	13.0	11.0	17.3	11.8	12.0	11.3	12.5	11.5	13.1
-7.5	12.0	13.3	13.7	14.7	13.0	10.8	19.0	13.8	13.0	10.5	9.5	12.3	13.0
-5	10.0	13.5	16.5	14.0	12.5	10.8	20.8	11.3	15.0	18.7	11.8	12.5	13.3

(Continued)

Table 20 (Concluded)

Range 1,000 ft	Predredge Survey Depth, ft, at Indicated Date of Survey												
	22 Apr 70	26 Apr 71	3 Apr 72	25 Apr 73	30 Apr 74	27 Apr 76	18 Aug 77	31 May 78	3 May 79	11 Jun 80	8 May 81	3 Jun 82	Mean
							South Half of Channel (Continued)						
-2.5	9.7	15.3	20.0	12.8	16.3	9.0	20.3	14.0	15.8	13.0	14.3	13.8	14.5
0	15.8	19.0	22.3	17.5	19.8	15.3	20.7	17.0	17.7	15.8	17.0	17.5	18.0
2.5	17.3	22.0	23.0	18.0	19.0	12.0	21.0	19.3	19.7	16.7	19.3	19.5	19.3
5	16.3	19.0	21.3	12.0	15.3	17.0	18.3	17.7	18.7	17.3	19.7	19.5	18.1
7.5	15.0	13.3	18.7	17.7	12.0	16.3	17.7	17.3	18.3	17.0	18.7	19.3	16.8
10	15.7	13.8	20.0	18.3	11.0	18.3	14.3	14.0	18.3	17.7	18.7	18.7	14.8
12.5	16.0	19.7	23.0	20.7	14.7	21.7	20.3	16.0	21.7	21.0	22.0	18.7	19.6
15	15.0	16.3	19.0	16.7	16.3	18.0	22.0	15.7	22.7	18.0	21.0	20.7	18.4
17.5	13.7	15.3	17.7	18.0	17.0	17.0	17.3	12.7	16.0	9.7	15.3	16.0	15.5
20	14.3	15.3	17.7	19.0	19.0	18.3	18.3	13.3	18.3	16.3	18.0	18.3	17.2
22.5	14.5	15.3	18.0	17.5	18.3	19.0	17.8	17.3	15.0	17.3	17.4	18.0	17.1
25	11.5	14.0	16.0	15.3	15.5	17.3	17.3	16.5	17.3	15.8	15.8	16.5	15.8
27.5	12.3	13.3	15.0	14.7	15.0	15.2	16.3	15.7	16.0	16.7	18.0	16.0	15.2
30	15.5	14.5	14.5	15.5	15.5	15.5	16.0	15.5	16.0	16.0	15.5	16.5	15.5
32.5	16.5	16.5	15.5	16.0	17.0	15.0	16.5	18.0	17.0	17.5	17.5	18.5	16.8
35	19.0	20.0	19.5	19.0	20.0	20.5	22.5	21.0	22.0	22.5	21.0	22.0	20.8
37.5	25.0	23.5	23.0	23.5	25.5	22.5	26.0	23.5	24.5	25.0	24.0	25.5	24.3
40	32.0	31.5	29.3	30.0	32.5	30.0	30.3	28.7	30.0	31.3	--	29.7	30.5

Table 21

Yaquina Bay Entrance Channel, 26-ft Project, North Half of Channel

Range 1,000 ft	Survey Depth, ft, at Indicated Date of Survey: Predredge 27 Mar 56	7 May 57	2 May 58	27 Apr 60	27 Apr 61	3 May 63	4 May 64	18 May 66	Mean	Postdredge 16 Jun 55	1 Oct 56	22 Jul 57	3 Sep 59	27 Sep 60	19 Sep 62	6 Aug 63	1 Oct 65	Mean
-50	--	42.0	--	--	40.3	41.0	--	41.3	41.2	41.0	42.0	43.0	--	--	41.3	40.3	40.3	41.3
-47.5	--	39.0	--	--	39.3	38.7	--	39.7	38.9	39.5	39.0	39.5	--	--	39.7	38.0	38.3	38.8
-45	--	38.0	--	0	37.0	36.3	--	36.0	36.8	35.5	37.5	37.5	--	--	37.7	36.3	35.7	36.7
-42.5	--	36.0	--	--	35.0	35.3	--	35.3	35.4	34.0	35.0	35.0	--	--	35.3	34.3	33.0	34.4
-40	--	34.0	--	--	34.0	34.7	--	36.0	34.7	32.5	35.5	34.0	--	--	34.7	33.7	32.7	33.9
-37.5	--	33.0	--	--	34.0	35.0	--	35.7	34.4	32.0	33.0	33.0	--	--	34.3	33.3	30.3	32.7
-35	--	32.0	--	--	34.7	34.0	--	35.3	34.0	30.7	31.0	31.0	--	--	34.0	32.3	28.3	31.2
-32.5	--	30.0	--	--	32.7	31.7	--	33.7	32.0	29.0	29.2	31.5	--	--	32.7	30.3	25.7	29.8
-30	30.0	28.0	29.3	32.7	31.3	29.0	30.7	31.0	30.0	27.7	29.0	32.7	31.7	30.5	30.7	29.0	28.0	29.9
-27.5	26.7	27.0	29.0	29.4	29.0	27.0	31.0	30.0	28.6	28.0	27.7	32.7	30.7	30.3	30.0	27.3	32.0	29.8
-25	26.3	26.5	26.3	28.3	25.3	25.0	32.0	27.0	27.1	29.0	29.0	32.0	29.0	28.8	28.0	26.3	35.0	29.6
-22.5	22.7	23.5	22.3	24.2	24.7	25.3	28.7	24.7	24.5	27.0	29.0	32.3	29.3	30.5	31.3	28.1	34.7	30.4
-20	21.0	22.0	23.0	22.5	28.3	27.3	25.3	26.0	24.4	25.5	29.0	28.1	29.3	30.7	30.3	29.7	30.3	29.1
-17.5	23.0	27.0	27.0	26.3	26.3	22.7	25.3	26.7	26.2	26.0	28.0	27.3	27.3	27.3	27.7	27.0	26.3	27.1
-15	25.5	25.3	25.3	26.0	24.7	27.0	25.7	27.0	25.8	24.5	25.3	26.5	24.7	25.3	26.7	26.0	25.7	25.6
-12.5	25.7	25.7	24.7	25.7	26.3	26.7	25.3	26.3	25.7	23.5	25.0	24.0	24.3	25.0	26.3	24.3	25.0	24.7
-10	24.7	24.0	23.3	25.7	25.3	25.7	24.7	26.3	25.0	22.7	24.7	24.0	24.0	25.0	25.7	24.3	24.7	24.4
-7.5	24.0	21.5	23.3	22.7	24.0	25.3	24.3	26.0	23.9	23.5	24.0	21.5	23.3	23.3	24.7	24.0	24.0	23.5
-5	23.5	22.0	22.0	23.0	23.3	24.3	23.0	24.7	23.2	22.7	22.0	22.5	22.0	22.3	25.3	24.0	23.3	23.0
-2.5	21.0	21.5	20.7	23.7	23.5	22.7	22.7	23.7	22.4	19.7	22.0	23.0	22.7	22.7	23.0	21.3	22.3	22.1
0	20.3	21.0	22.0	20.7	22.7	20.7	20.7	24.0	21.5	19.5	21.5	21.0	21.3	22.3	23.3	22.3	23.3	21.8
+2.5	20.0	22.3	21.7	23.3	23.7	24.0	20.7	25.7	22.7	20.7	23.0	23.5	24.0	24.7	25.3	23.3	24.3	23.6
+5	17.3	32.0	20.7	22.3	22.7	23.7	19.7	27.0	21.9	22.0	23.7	25.7	24.3	25.7	27.0	23.3	26.0	24.7
+7.5	16.7	18.3	18.0	18.3	19.0	21.3	17.0	25.7	19.3	21.0	20.7	22.0	22.5	22.3	21.3	20.7	25.0	22.2
+10	17.7	16.3	16.7	16.3	17.0	19.0	18.0	23.3	18.0	22.3	21.0	22.5	20.7	21.3	21.7	19.3	22.0	21.4
+12.5	20.0	19.0	17.7	19.0	20.0	19.3	19.7	20.3	19.4	21.3	21.7	21.5	21.3	22.0	22.3	21.0	21.7	21.6
+15	19.3	20.5	19.3	20.3	21.3	20.7	21.3	23.7	20.8	22.3	21.7	23.3	22.7	21.5	23.0	21.7	23.0	22.4
+17.5	20.0	19.5	18.7	20.5	19.3	20.7	20.3	21.7	20.1	19.7	22.0	21.7	21.0	20.8	21.3	20.3	21.0	21.0
+20	20.0	20.5	20.7	20.8	21.0	21.3	21.3	24.0	21.2	21.0	21.3	22.0	23.0	21.5	22.3	20.7	22.0	21.7

Table 22

Yaquina Bay Entrance Channel, 26-ft Project, South Half of Channel

Range 1,000 ft	Survey Depth, ft, at Indicated Date of Survey: Predredge: 27 Mar 56	7 May 57	2 May 58	27 Apr 60	27 Apr 61	3 May 63	4 May 64	18 May 66	Mean	Postdredge: 16 Jun 55	1 Oct 56	22 Jul 57	3 Sep 59	27 Sep 60	19 Sep 62	6 Aug 63	1 Oct 65	Mean
-50	--	40.7	--	--	39.0	40.0	--	39.0	39.7	40.0	41.0	42.0	--	--	40.3	39.3	38.7	40.1
-47.5	--	38.5	--	--	37.7	37.3	--	37.0	37.3	37.5	38.5	39.0	--	--	37.7	37.3	36.3	[illegible]
-45	--	35.5	--	--	36.0	35.3	--	35.0	35.5	34.0	36.5	36.0	--	--	25.3	35.0	34.0	[illegible]
-42.5	--	34.5	--	--	33.0	34.3	--	36.0	34.5	33.0	34.0	33.0	--	--	34.7	33.3	31.7	[illegible]
-40	--	30.5	--	--	34.0	34.3	--	36.0	33.7	30.0	37.0	32.0	--	--	35.0	31.0	31.7	32.8
-37.5	--	34.0	--	--	34.7	35.3	--	34.0	34.5	31.5	34.0	34.0	--	--	34.3	33.0	28.7	32.6
-35	--	32.0	--	--	34.3	33.0	--	33.0	33.1	31.0	31.3	31.0	--	--	32.7	31.7	28.0	31.0
-32.5	--	29.0	--	--	32.0	30.7	--	31.0	30.7	29.5	29.3	31.0	--	--	31.7	30.0	26.3	29.6
-30	28.7	28.0	29.5	31.5	29.3	27.3	30.7	27.7	29.1	27.5	28.0	32.0	32.3	28.3	30.0	28.3	29.0	29.4
-27.5	25.3	27.0	28.0	28.3	26.7	25.0	31.3	24.7	27.0	28.5	26.3	32.3	30.7	28.7	30.0	25.7	32.7	29.3
-25	24.0	26.0	25.5	27.0	23.3	23.7	31.0	22.0	25.3	27.7	29.7	32.0	31.7	30.3	32.3	29.7	33.7	30.9
-22.5	20.7	24.0	22.0	23.7	23.3	24.0	28.0	20.0	23.2	26.0	31.3	30.0	32.7	32.3	32.3	31.0	31.7	30.9
-20	20.3	22.0	22.5	23.0	26.0	25.3	25.0	20.0	23.0	25.5	27.0	25.5	27.7	29.3	28.7	28.3	27.7	27.5
-17.5	23.0	25.0	25.0	25.7	25.7	27.0	26.0	22.7	25.0	24.5	25.0	25.5	27.0	27.0	27.3	25.7	25.7	26.0
-15	23.7	24.0	24.0	25.3	25.0	26.3	25.3	25.7	24.9	25.0	25.7	26.0	23.7	26.3	27.0	25.0	25.7	25.6
-12.5	24.3	24.0	24.7	26.3	25.3	26.0	25.7	26.0	25.3	23.3	25.7	26.0	24.3	25.0	26.7	26.0	25.3	25.3
-10	23.0	22.0	21.7	23.3	25.3	25.0	24.7	25.7	23.8	21.3	23.7	21.5	23.0	23.7	24.7	23.3	23.3	23.1
-7.5	24.3	23.0	23.3	24.3	24.3	25.3	25.0	26.0	24.4	23.5	24.3	24.0	23.7	24.3	25.3	23.7	24.3	24.1
-5	24.0	23.0	22.7	25.0	24.0	25.3	25.7	24.3	24.3	23.0	23.0	22.5	24.3	25.0	25.7	25.0	25.0	24.2
-2.5	20.8	22.0	20.0	20.3	21.7	22.0	23.3	19.7	21.2	20.0	24.5	23.5	31.7	22.3	22.7	21.7	21.7	22.3
0	20.7	22.5	21.0	23.0	21.7	23.0	23.0	21.7	22.1	20.7	22.5	23.4	22.3	23.3	25.0	23.0	23.7	23.0
+2.5	20.0	21.3	20.3	23.0	22.3	22.3	22.3	23.3	21.9	20.3	22.5	23.5	20.3	22.0	23.0	21.0	22.0	21.8
+5	25.0	24.5	24.3	25.0	24.7	24.0	24.0	24.3	24.5	24.0	26.5	26.0	25.3	26.0	27.0	25.3	25.0	25.6
+7.5	23.5	23.0	22.3	23.7	22.7	23.7	22.0	24.3	23.2	22.7	24.0	25.0	24.5	25.3	24.7	23.3	23.7	24.2
+10	22.3	21.7	20.7	20.7	21.7	22.0	22.0	22.7	21.7	23.0	24.7	24.0	23.5	24.0	24.0	22.3	23.0	23.6
+12.5	23.0	23.0	21.0	22.7	22.3	22.3	22.3	24.0	22.6	22.7	24.3	24.0	23.0	23.3	23.7	22.7	23.7	23.4
+15	23.0	22.5	22.7	23.3	23.3	23.3	24.0	25.3	23.4	25.0	24.7	26.3	25.0	25.0	25.3	24.3	24.0	25.0
+17.5	22.7	21.0	21.7	22.0	21.0	22.3	22.3	23.3	22.0	21.5	24.3	22.0	22.0	23.0	23.0	22.3	22.3	22.4
+20	21.0	21.0	20.7	20.7	20.0	21.3	20.7	24.0	21.2	21.0	21.3	21.5	22.0	21.3	21.3	21.0	21.0	21.3

Table 23

Yaquina Bay Entrance Channel, 40-ft Project, North Half of Channel

Range	Survey Depth, ft, at Indicated Date of Survey									
	Predredge					Postdredge				
1,000 ft	25 Apr 73	13 Mar 75	12 Apr 76	15 Jun 77	Mean	29 Aug 72	1 Aug 74	22 Jul 75	9 Aug 76	Mean
-50	42.2	44.0	42.0	44.0	43.2	44.8	46.8	46.2	46.0	45.8
-47.5	39.8	41.8	41.0	42.8	46.4	43.6	44.8	45.4	45.4	44.8
-45	38.6	41.2	40.0	41.2	40.3	42.6	43.6	45.0	45.4	44.2
-24.4	38.2	40.6	39.0	40.6	39.6	43.0	43.8	45.4	45.8	44.5
-40	38.2	40.8	38.6	40.0	39.4	45.0	45.6	46.2	46.0	45.7
-37.5	37.4	40.0	37.6	39.4	38.6	47.6	45.8	46.6	45.6	46.4
-35	34.6	37.8	35.6	38.2	36.6	44.2	45.4	44.2	44.6	44.6
-32.5	31.4	34.6	33.2	36.0	33.8	40.0	41.2	42.2	41.4	41.2
-30	31.4	32.6	32.2	40.8	34.3	44.0	43.2	44.8	45.0	44.3
-27.5	45.6	40.4	37.6	50.6	43.6	50.6	49.6	49.2	47.8	49.3
-25	43.2	47.2	43.8	44.6	44.7	44.8	44.4	44.8	43.6	44.4
-22.5	34.8	43.4	42.0	45.0	41.3	43.8	43.8	44.4	44.2	44.1
-20	32.2	40.6	38.8	42.6	38.6	42.4	41.8	43.4	42.6	42.6
-17.5	32.2	39.6	35.6	39.4	36.5	42.0	41.2	42.2	43.0	42.1
-15	33.8	37.0	33.2	37.8	35.5	40.8	40.4	41.6	40.8	40.9
-12.5	36.0	38.4	35.6	39.0	37.3	41.0	40.8	42.4	41.8	41.5
-10	37.0	38.4	37.0	40.2	38.2	40.2	40.4	42.8	41.8	41.3
-7.5	37.2	37.8	37.0	39.0	37.8	39.6	37.8	39.4	39.8	39.2
-5	35.2	36.8	35.6	36.8	36.1	36.2	35.2	36.8	36.8	36.3
-2.5	33.4	35.0	33.0	35.4	34.4	34.6	34.4	34.8	35.2	34.8
0	33.0	33.0	32.8	34.8	33.4	34.4	33.6	35.0	35.0	34.5
+2.5	34.4	34.0	32.8	36.6	34.5	35.0	37.0	36.0	36.0	36.0
+5	32.8	32.8	31.8	33.6	32.8	34.4	33.6	33.8	34.2	34.0
+7.5	32.6	32.8	32.0	34.4	32.7	35.6	34.0	32.6	33.4	33.9
+10	33.2	32.4	30.6	33.2	32.1	34.0	33.6	33.0	32.8	33.4
+12.5	31.0	32.8	31.0	33.4	32.1	33.4	33.6	33.4	31.8	33.1
+15	31.6	32.8	31.8	34.0	32.6	33.0	33.2	34.0	33.4	33.4
+17.5	32.2	33.2	32.4	34.8	33.2	34.4	33.8	34.6	34.0	34.2
+20	33.0	33.8	33.6	35.0	33.9	33.6	34.0	34.6	34.8	34.3

Table 24

Yaquina Bay Entrance Channel, 40-ft Project, South Half of Channel

Range	Survey Depth, ft, at Indicated Date of Survey									
	Predredge					Postdredge				
1,000 ft	25 Apr 73	13 Mar 75	12 Apr 76	15 Jun 77	Mean	29 Aug 72	1 Aug 74	22 Jul 75	9 Aug 76	Mean
-50	40.2	42.0	41.8	43.6	44.9	43.6	45.2	43.6	46.6	44.5
-47.5	36.2	40.6	40.0	42.0	40.2	43.8	46.2	44.6	46.4	45.3
-45	[illegible]	39.8	39.0	40.6	39.3	41.0	44.8	43.0	46.0	43.7
-24.4	37.8	40.8	39.0	39.8	39.4	41.2	45.6	42.8	45.6	43.8
-40	[illegible]	42.6	39.6	39.4	40.0	43.0	48.2	44.6	46.0	45.5
-37.5	37.8	41.8	39.6	39.8	39.8	44.4	45.0	44.4	46.0	45.0
-35	35.6	38.4	38.8	39.0	38.0	41.0	47.0	43.4	45.2	44.2
-32.5	30.6	36.4	37.6	37.2	35.5	41.8	44.8	41.6	41.6	42.5
-30	33.0	37.6	34.8	44.4	37.5	45.6	46.0	42.6	46.4	45.2
-27.5	39.0	44.0	42.2	50.2	43.9	46.2	48.0	48.0	49.6	48.0
-25	35.2	41.0	43.6	44.8	41.2	41.6	44.0	45.6	44.4	43.9
-22.5	26.2	36.2	39.0	43.6	36.6	39.6	41.8	44.4	44.0	42.5
-20	25.8	34.4	32.8	40.2	33.3	39.6	41.8	43.2	41.8	41.6
-17.5	28.4	34.4	29.6	37.0	32.4	39.6	42.0	42.6	42.0	41.6
-15	29.2	33.4	30.4	36.4	32.4	40.4	41.6	42.0	41.0	41.3
-12.5	28.6	32.6	28.4	35.0	31.2	41.2	40.6	41.4	40.4	40.9
-10	30.6	31.0	29.2	34.0	31.2	39.0	41.2	40.6	40.8	40.4
-7.5	31.6	30.0	29.6	34.2	31.4	36.6	38.2	39.2	39.0	38.3
-5	32.6	31.0	29.8	33.4	31.7	36.2	37.8	38.4	37.2	37.4
-2.5	32.8	33.0	31.4	33.2	32.6	35.2	35.8	36.4	36.6	36.0
0	33.2	33.8	33.2	34.2	33.6	35.4	35.6	35.2	36.0	35.6
+2.5	34.6	34.8	33.6	36.4	34.9	36.4	36.6	36.6	37.8	36.9
+5	34.0	34.4	33.6	34.0	34.0	34.8	34.6	33.6	35.4	34.6
+7.5	35.0	35.2	34.8	37.8	35.7	36.4	37.4	36.2	37.0	36.8
+10	33.8	35.0	34.2	36.2	34.8	35.6	35.8	35.8	36.2	35.9
+12.5	34.4	35.0	34.4	36.6	35.1	35.2	36.2	36.2	36.4	36.0
+15	33.6	33.6	33.8	36.0	34.3	34.4	34.0	35.0	35.2	34.7
+17.5	33.6	33.4	33.0	35.2	33.8	34.4	34.0	34.4	34.8	34.4
+20	33.2	33.8	33.2	34.4	33.7	33.8	34.1	33.8	34.2	34.0